GENERAL LIBRARY
NOV 2 1918
UNIV. OF MICH.

Vol. LXVIII OCTOBER, 1918 No. 4

ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

Edited by
LEWIS STEPHEN PILCHER, M.D., LL.D.
of New York

With the Collaboration of
SIR WILLIAM MACEWEN, M.D., LL.D. of Glasgow
SIR W. WATSON CHEYNE, C.B., F.R.S. of London

THE TREATMENT OF TUMORS OF THE SUPERIOR MAXILLA . . . 353
HENRY H. JANEWAY, M.D. . . . New York
THE OPERATIVE TREATMENT OF TRIFACIAL NEURALGIA . . . 371
WILLIAM SHARPE, M.D. . . . New York
A NOTE ON THE SURGICAL TREATMENT OF CERTAIN DISEASES BY SPLENECTOMY . . . 379
JAMES SHERREN, F.R.C.S. (ENG.) . . . London
SURGICAL ASPECTS OF RIGHT SUBPHRENIC ABSCESS . . . 383
JOSEPH BURKE, M.D. . . . Buffalo
HYPERNEPHROMA OF THE FALCIFORM LIGAMENT OF THE LIVER . . . 395
ANTHONY H. HARRIGAN, M.D. . . . New York
THE LOW LATERAL INCISION AND A METHOD OF NERVE BLOCK FOR APPENDECTOMY . . . 397
LEIGH F. WATSON, M.D. . . . Chicago
SURGICAL PATHOLOGY OF THE HUMAN PROSTATE GLAND . . . 399
OSWALD S. LOWSLEY, M.D. . . . New York
THE HUMAN SEMINAL VESICLES AT BIRTH . . . 416
ERNEST M. WATSON, M.D. . . . Buffalo
TRANSVERSE ECTOPY OF THE TESTIS WITH MASCULINE UTERUS . . . 420
T. KIMURA, M.D. . . . Kyoto
GIANT-CELL GROWTH OF BONE AND TENDON SHEATH . . . 426
LEONARD W. ELY, M.D. . . . San Francisco
INTESTINAL OBSTRUCTION PRODUCED BY THE EVAGINATION OF ILEUM INTO THE URINARY BLADDER . . . 429
W. HOWARD BARBER, M.D. . . . New York
SURGICAL CLOSURE OF WOUNDS . . . 430
GEORGES DEHELLY, M.D. . . . Le Havre
THE PHYSICAL FACTORS INFLUENCING INFECTION . . . 436
WALTON MARTIN, M.D. . . . New York
BOOK REVIEWS . . . 446
CORRESPONDENCE . . . 455

J. B. LIPPINCOTT COMPANY, PUBLISHERS
PHILADELPHIA
MONTREAL LONDON

Entered at the Post-Office at Philadelphia and admitted for transmission through the mails at second-class rates. Price, $6.00 a year. Copyright, 1918, by J. B. LIPPINCOTT COMPANY, 227-231 South Sixth Street.

Stanolind

Reg. U. S. Pat. Off.

Surgical Wax

A new dressing for burns, granulations and similar lesions.

Manufactured by the Standard Oil Company of Indiana, and guaranteed by them to be free from deleterious matters, and so packed as to insure it against all contamination.

Stanolind Surgical Wax has a sufficiently low melting point so that when fluid the possibility of burning healthy tissue is precluded.

Its correct ductile and plastic features make it adaptable to surface irregularities without breaking.

When properly applied it adheres closely to sound skin, yet separates readily and without pain from denuded surfaces.

Stanolind Surgical Wax when applied in proper thickness maintains a uniform temperature, promoting rapid cell growth, and assisting nature to make repairs quickly.

Stanolind Petrolatum

A New, Highly Refined Product

Vastly superior in color to any other petrolatum heretofore offered.

The Standard Oil Company of Indiana guarantees, without qualification, that no purer, no finer, no more carefully prepared petrolatum can be made.

Stanolind Petrolatum is manufactured in five grades, differing one from the other in color only.

Each color, however, has a definite and fixed place in the requirements of the medical profession.

"Superla White" Stanolind Petrolatum.

"Ivory White" Stanolind Petrolatum.

"Onyx" Stanolind Petrolatum.

"Topaz" Stanolind Petrolatum.

"Amber" Stanolind Petrolatum.

The Standard Oil Company, because of its comprehensive facilities, is enabled to sell Stanolind Petrolatum at unusually low prices.

STANDARD OIL COMPANY

(Indiana)

Manufacturers of Medicinal Products from Petroleum

910 S. Michigan Avenue Chicago, U. S. A.

754

ANNALS *of* SURGERY

VOL. LXVIII OCTOBER, 1918 No. 4

THE TREATMENT OF TUMORS OF THE SUPERIOR MAXILLA

BY HENRY H. JANEWAY, M.D.

OF NEW YORK

DURING the past three and a half years, fifty-five patients with tumors of the superior maxilla have been treated at the Memorial Hospital by radium, assisted when necessary by a conservative operation. These tumors have included eight benign tumors and forty-seven malignant growths, of which four were sarcomas and forty-three epitheliomas.

The anatomical classification of these tumors in one group belonging to the upper jaw is somewhat arbitrary, because the superior maxilla forms the walls of at least three well separated cavities, the antrum, the nose, and the mouth. The vast majority of the tumors originate from the mucosa lining the walls of these cavities, and the mucosa of each cavity presents somewhat different characters. Nevertheless, the new growths, originating in all three of these cavities, present similar clinical and therapeutic problems, and this fact justifies grouping them together.

Benign Tumors.—Of the benign tumors the papillomas are the simplest. There are two very definite varieties of papilloma. One is the simple circumscribed papilloma, showing little tendency to metaplasia and resembling in every way the similar and far more common warts of the skin.

Only one patient, Hospital No. 23827 of our series, possessed one of these growths. It grew from the mucosa, covering the inferior surface of the palatine process of the superior maxilla of a woman forty-nine years of age. The tumor had been growing, before she applied for treatment, for one and a half years. She received a single treatment of radium on February 8, 1917, 225 mc. having been applied in three rubber-covered platinum tubes for two hours. A complete disappearance of the growth resulted.

These tumors are more frequent on the tongue and lip and, in these regions, after varying lengths of time, they may undergo malignant transformation, doubtless because on the tongue, but more especially on the lip, they are subject to frequent trauma.

The other variety of papilloma is a much more important tumor. It forms, early in its growth, sessile and very superficial minute papillary projections, which spread superficially over large surfaces. At the starting place, these tumors are prone, after a longer or shorter time, to deeply infiltrate and become true epithelioma.

An example of such a tumor is A. M., Hospital No. 25090. The microscopical examination of the specimen removed from the surface of the

growth showed a papilloma, but the base at the center of the growth was infiltrating and possessed potentially all the life-destroying characters of true cancer. In another patient not included in this series a growth starting in the lower alveolus and involving, at the time he applied for treatment, the soft palate, cheek and lip, showed the same type of papilloma in the first specimen examined, but a deeper specimen obtained at a later date showed fully developed epidermoid carcinoma.

Another patient, J. K., Hospital No. 25190, who had, at the time he came for treatment, fully developed epidermoid cancer of the whole of both superior alveolar processes and the intervening palatine processes of the superior maxilla, developed his cancer from an invasive growth of one of these papillary superficial growths starting seven years before.

These papillary growths are easily cured by surface applications of radium. We have obtained a good result in practically all of them, and such a result is nothing short of curing cancer.

The case of myxoma occurred in a young girl, eighteen years of age. It was first noticed seven months before she applied for treatment. The first symptom was a swelling of the face below the eye and to the side of the nose. The growth showed itself very susceptible to radium and was cured, but unfortunately the treatment was unnecessarily severe and caused some facial deformity.

Closely allied to the myxomas are the fibrosarcomas. We have met with two of these growths. In both patients the tumors started to grow in the nose and subsequently invaded the antrum. While both patients showed a susceptibility to radium, the treatment was not successful, due chiefly to the late stage and very large size of the growths at the time the treatment was applied. In these late growths, completely blocking the air passages and producing distention of the nasal and antral cavities, it is wiser to relieve the patient in part by a preliminary operation, which serves also another purpose of rendering the pedicle of the growth more accessible to the subsequent application of radium. By so doing, the dangers of infection and post-treatment swelling, which in one of these advanecd cases actually led to suffocation, will be greatly diminished. At the present time we are treating a third case of fibroma or fibrosarcoma of the nasal cavity of smaller size. It does not originate from the mucous membrane covering the superior maxilla, but more posteriorly from that over the adjacent portion of the palate bone.

This growth was recurrent after operation, and it has been treated by embedding within it unfiltered glass emanation tubes. The improvement to date has been satisfactory.

The osteomas of the antrum form an interesting group of tumors. Two patients have come under our care.

While radium cannot reduce these growths in size because of the fact that the dense bone of which these growths are formed does not become absorbed, it is of material service in stopping further growth.

Our first patient was a boy, twelve years old. The tumor was first noticed several months before he applied for treatment, and, according to the family's statements, had been gradually becoming larger. Our treatment consisted in chiselling away the bulk of the tumor through an opening made within the mouth in the anterior wall of the antrum. This operation consisted practically of carving out a new antrum from the solid bone which completely filled the former antral cavity and had become consolidated with its walls.

After the operation 50 mc. of radium emanation filtered through 0.5 mm. silver were placed in the cavity for six hours. Following this treatment, administered October 20, 1915, there has been some continuous diminution in the slight residual prominence of the left cheek and certainly no continued growth of the bony tumor. The result, therefore, to date is most satisfactory from both a cosmetic and a functional standpoint.

The second patient, Hospital No. 25108, was a woman, 62 years old, who had first noticed a swelling of the face one and a half years ago. The usual operation of removal of the floor of the antrum, done in the radium department of this hospital, for exposure of the antral cavity, was performed, and a large part of the tumor removed. The remainder of the tumor was treated with radium. Complete healing soon followed, and the patient has been free from any further increase in size of the growth since the treatment; and, also, from any inconvenience in the normal function of the mouth.

Of two patients with giant-cell sarcoma, the one received a single treatment with, in so far as could be ascertained, complete retrogression. This patient died later of some unknown cause. She was a woman fifty-eight years of age, whose attention was first attracted to her disease one year before applying for treatment by the appearance of a nodule in the neighborhood of the left lateral incisor tooth. At the time of treatment a sinus had been created by an operation and the sinus was continuous with tumor tissue inside the antrum. The second patient, Hospital No. 25324, is a young girl, sixteen years of age. She first noticed symptoms four months before admission. These symptoms were a diffuse swelling of the right side of the roof of the mouth and a little later epiphora and nasal obstruction. The swelling in the mouth was incised at another hospital under the impression that it was inflammatory. At the time of admission the right side of the face was much swollen. The palatine and alveolar processes of the superior maxilla were depressed, and a mass of new growth obstructing the nose could be seen through the anterior nares. The patient is still under observation at the hospital.

The single patient with chondroma of the superior maxilla, Hospital No. 25395, possessed a previous history of his lesion of ten years' duration. The tumor began to grow in the left antrum. It recurred after operation in both superior maxillæ, completely blocking both sides of the nose. In structure the growth showed large spindle cells so that the tumor is more strictly a chondrosarcoma, but clinically

it is quite benign in its course. The patient received treatment from unfiltered glass emanation tubes embedded in the substance of the tumor. Little retrogression up to the present time has taken place, the patient having only received treatment on April 24, 1918.

The single case of melanosarcoma of the superior maxilla was unaffected by radium therapy. The history of this patient, Hospital No. 23921, is one of considerable interest, as these tumors are rare in this location. The growth developed in a man, fifty-two years of age, in the left superior alveolar process in 1911. It gradually increased in size, and was operated on in March, 1912. In December, 1915, local recurrence was noticed, and enlargement of the cervical lymph nodes. These were removed in December, 1916. Following this operation and the treatment by radium soon afterwards, the patient's general health and strength rapidly deteriorated.

The microscopical sections of the tissue, taken from within the mouth, show a moderately cellular tumor involving the epithelial layers of the alveolus and underlying tissues. It is composed of long spindle cells, closely packed together and lying in a dense intercellular substance. The epithelial layer is invaded in numerous places by the tumor cells. Heavily pigmented cells are present below and within the epithelial layer, and in foci throughout the tumor, and especially in large spindle and polyhedral cells about the edges of the tumor cell groups.

Malignant Epithelial Tumors of the Upper Jaw.—Of all the tumors of the upper jaw, carcinoma attracts the most attention, first, because of its by no means infrequent occurrence, and, second, because of the serious nature of the course which it runs.

In our series, it occurred no less than forty-three times among fifty-five patients with tumors of the upper jaw. The following shows the relative frequency of the various tumors of our series: Carcinoma, 43; sarcoma, 3; melanosarcoma, 1; papilloma, 2; osteoma, 2; chondroma, 1; fibroma, 2; myxoma, 1.

Carcinoma of the superior maxilla is, therefore, by far the most frequent tumor of the superior maxilla; all other tumors being relatively so infrequent that they may be considered rare.

Between the years 1915 and 1917, inclusive, 1892 patients with malignant tumors were admitted to the Memorial Hospital; 48, or a percentage of 2.53, of these were cancers of the superior maxilla.

During the same period, 786 patients were treated in the radium department, and of these 40 were malignant new growths of the superior maxilla, a percentage of 5.08.

Of the 786 patients admitted to the radium service, 353 patients had cancer of the mucous membrane of lip, interior of the mouth, pharynx, larynx, and œsophagus, of which the 40 malignant tumors of the superior maxilla form 11.33 per cent.

Of the 1892 patients admitted to the hospital during the three years,

1915 to 1917, 285 patients had sarcoma. Deducting these, there were 1607 patients with malignant epithelial tumors. Of this number,

38, or 2.35 per cent., were cancers of superior maxilla;
53, or 3.29 per cent., were cancers of the lip;
115, or 7.16 per cent., were cancers of the tongue.

Cancer of the superior maxilla is, therefore, almost three-fourths as frequent as cancer of the lip, and one-third as frequent as cancer of the tongue.

The site of origin of cancers of the upper jaw bears a direct relation to the prognosis. They may be divided into antral, nasal, and oral. It is not always possible, at the time the patient comes for treatment, to distinguish between the tumors which are primary in the antrum and those primary in the nasal cavity. For this reason, a more practical classification might be the antro-nasal tumors, and the oral tumors.

In twenty-one of our patients the tumors began to grow in the mouth upon the superior alveolus.

In eighteen patients the growth was judged to have originated within the antrum, but of this number the antral origin of six was somewhat doubtful.

In the case of four patients, the disease originated either within or in close relation to the nasal cavity.

The following table gives the distribution of these growths according to sex and side of the body affected:

	No.	Male	Female	Right	Left	Both
Oral cases	21	17	..	10	5	2
	..	..	4	2	2	..
Antral cases	18	11	..	6	5	..
	..	..	7	5	2	..
Nasal cases	4	3	..	3	..	..
	..	..	1	1	..	..
	43	31	12	27	14	2

The table shows that a majority of the lesions occurred in the male sex, and on the right side of the head. The explanation of the greater frequency in the male sex and of the greater frequency of involvement of the right side in both sexes is a matter of speculation.

The mucous membranes of the male sex are subjected to more chronic irritation. Men smoke more than women, they are engaged in occupations subjecting them to the inhalation of dust and inflammatory conditions depending upon outdoor occupations more than women. One very probable factor, accounting for the greater frequency of the oral cases among men, is the greater neglect of the teeth by men and the irritating effects of chewing tobacco. In the majority of the oral cases of this series the teeth

were decayed or covered with deposits, and surrounded by pyorrheal pockets. There are, however, no facts which support the view, that habit subjects the right side of the mouth to such irritation more than the left side.

In only seven of the patients was there a history of heavy smoking, and in two others, a history of chewing tobacco. In seven of the patients the beginning of the disease was associated with loosening of the teeth, or decayed teeth, but there is no definite evidence to show whether this condition of the teeth was a result or a cause of the disease. In one of the antral cases there had been a prolonged history, extending over years, of nasal polypi before the onset of the trouble. In another patient trauma from a broken piece of enamelware directly preceded the development of the growth.

Age.—Sixty-nine per cent. of the cases occurred between the ages from forty-five to seventy, and 28.5 per cent. between fifty and sixty years of age.

The following table shows the number of cases occurring in the different five-year periods from fifteen years of age to seventy.

	15–19		20–29		30–34		35–39		40–44		45–49		50–54		55–59	60–64		65–69		70
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Male	Female	Male	Female	Male
Oral cases...	..	..	1	..	1	..	1	..	..	..	2	1	1	..	5	..	1	4	1	2
Antral cases.	..	..	..	..	2	1	1	2	..	1	1	2	4	2	..	1	..	2	..	..
Nasal cases..	..	1	1	..	..	..	..	..	..	..	1	..	..	..	..	1	..	..	..	..
	..	1	2	..	3	1	2	2	..	1	4	3	5	2	5	2	1	6	1	2

SYMPTOMS OF ONSET AND DURATION OF THE DISEASE BEFORE APPLICATION FOR TREATMENT.

The symptoms of onset are of much importance, as so much can be accomplished with these cases when treated early.

The oral cases are the easiest to diagnose in the early stage, and in the majority of these the first symptom is ulceration. A few complained of loosening of the teeth in the superior alveolus. The subsequent symptoms are increase in size of the ulcer, swelling of the superior alveolus and later of the face. An intelligent patient will usually seek medical advice when the lesion is small.

In the antral cases the first symptom may be any one of the following named in order of their frequency:

Irritation of the eye, due probably to obstruction of the lachrymal duct, swelling of the face or alveolus, nasal obstruction, or pain or loosening of the upper teeth.

Among the nasal cases, nasal obstruction and discharge and irritation of the conjunctiva were the initial symptoms. Any recurrent or persistent conjunctival irritation, not affecting the whole conjunctiva uniformly but more intensely the conjunctiva in the neighborhood of the lachrymal duct,

particularly if coupled with some nasal obstruction, coming on without the ordinary symptoms of a cold in the head, should excite the suspicion of being caused by a tumor within the antrum. Transillumination and a radiograph then become valuable diagnostic aids.

Sooner or later, there is marked swelling of the face and alveolus with evident distention of the antrum, more complete nasal obstruction, or if the orbit becomes invaded, which it frequently does in the nasal cases, exophthalmos develops. Pain now becomes added to the other symptoms, nutrition becomes interfered with, and the patients progressively lose in weight and strength, until death occurs. Figures 1 and 2 illustrate well the swelling of the face.

The regional lymphatics become involved rather late in the course of the disease. The following table gives the average duration of the disease from the time when symptoms were first noticed until (in the first column) the patients applied for treatment and (in the second column) until they were referred to us. In the third column is the average total duration of the disease in the case of those patients who died, and in the fourth column the percentage of patients who developed enlarged regional lymphatics; at least as long as they were followed by us, which represents the whole of the disease in many and most of it in others.

	Average duration of the disease before applying for treatment	Average duration of the disease before being referred to us
Oral cases	7.1 months	13.7 months
Antral cases	4 months	14.3 months
Nasal cases	5.75 months	5.75 months

	Average length of the disease in those patients who have died		Percentage of cases developing enlarged cervical lymphatics		
Oral cases	13.8 months	Average of 4 cases only, the others still living	Lymphatic involvement		
				with	without
Antral cases	12.4 months	Average of 5 cases only	Oral cases	7	14
			Antral cases	6	12
Nasal cases	5 months	Average of 2 cases only	Nasal cases	1	3

Among the oral cases the shortest duration before applying for treatment was one month, the same case having been referred to us five months from the initial symptom, and the longest duration before treatment twenty-four months; among the antral cases, the shortest duration of the disease before the application for treatment was one month, the same case being referred to us three months from the appearance of the first symptoms. The longest duration of the antral cases before treatment was 156 months, the next longest 24 months, and the next 12 months. Among the nasal cases the shortest duration of the disease before applying for treatment was one month, the same case being referred to us two months from the onset.

The longest total duration was eleven months. Malignant new growths of the superior maxillary bone untreated run their whole course most frequently well inside of one year, few lasting as long as two years; and whenever the total duration of the disease is over one year, it is due to the fact that histology represents a specially benign type of growth, or the administration of a more or less successful treatment.

THE PATHOLOGY OF CARCINOMA OF THE SUPERIOR MAXILLA.

Aside from the adamantinomas, of which we have no examples in our series though the tumor occurs in the superior maxilla, we have met with four types of epidermoid cancer of the superior maxilla which present both different clinical features and different pathological pictures.

The simplest form of cancer of the superior maxilla possesses a papillary structure (Fig. 3). Its epithelial cells form solid intertwining columns with no invasion of the intervening connective tissue. The cells and their arrangement are atypical, and their growth is unrestrained. We have met with two examples of this growth, F. H., Hospital No. 24423, and H. W., Hospital No. 25176. Both growths occurred in comparatively young individuals. F. H. was a woman of forty years, and H. W. a man of thirty-eight. Both had a previous long history, one thirteen years, and the other eighteen years, the growth showing no tendency to metastasize, simply progressively increasing in size until interrupted by a more or less successful operation. When these patients applied to us for treatment, their tumors distended the antrum, and filled the nasal cavity of one side, and death seemed, and probably was, near.

In the case of F. H., a single application of radium, embedded as emanation in unfiltered glass tubes in the center of the growth, caused a complete retrogression with no return to date, an interval now of one year. H. W. is still under treatment. At some time in their course these tumors take on a rapid growth and quickly terminate life.

Possessing from the beginning true invasive characters are two varieties of carcinoma of the superior maxilla. Both are typical epidermoid cancer.

One of these is the ordinary squamous cell cancer, containing pearls, and composed of large atypical pavement cells of the spinous type or type of the more superficial layer of cells of squamous epithelium (Fig. 4).

These tumors belong, so far as we could ascertain, entirely to the oral group of cancers of the superior maxilla.

They are very malignant, though following the rule of most of the malignant growths of the superior maxilla, they involve the regional lymphatics late, causing death usually by a rapid local growth.

The other type of invasive epidermoid cancer has been found chiefly among those tumors originating within the antrum. The sections all show basilar cell features. The epithelial elements show groups or strands of cells lined peripherally by a layer of atypical cuboidal or columnar cells (Figs. 5 and 6).

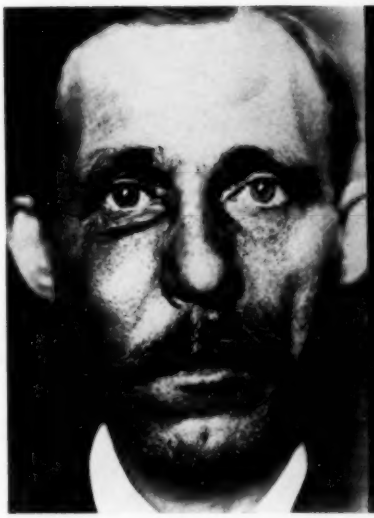

FIG. 1.—Illustrating distention of the face by epithelioma of the antrum. This patient is now apparently cured.

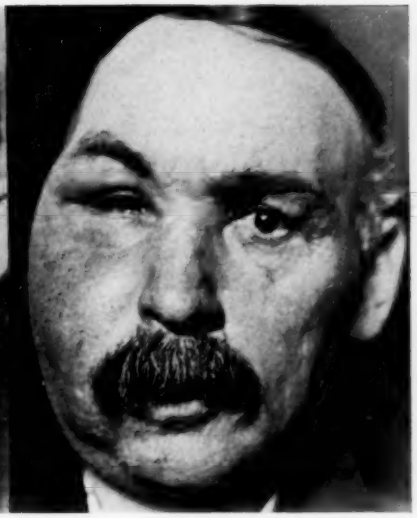

FIG. 2.—Illustrating swelling of the face caused by epithelioma primary in the superior alveolus.

FIG. 3.—Papillary carcinoma of the superior maxilla.

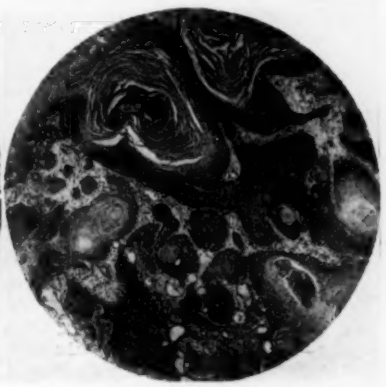

FIG. 4.—Epithelioma of the squamous-cell type, epithelioma spinocellulare, of the superior maxilla.

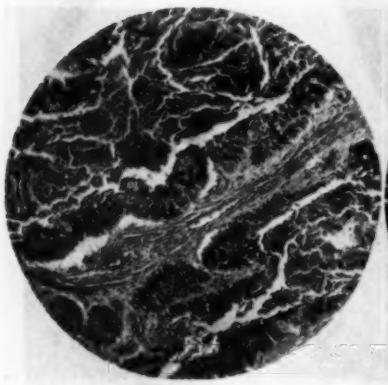

FIG. 5.—Epithelioma of the cylindrical-cell type, epithelioma basocellulare, of the superior maxilla.

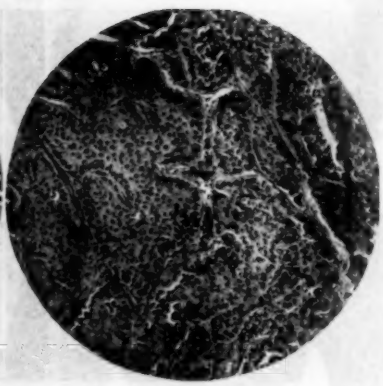

FIG. 6.—Epithelioma of the cylindrical type, epithelioma basocellulare, of the superior maxilla.

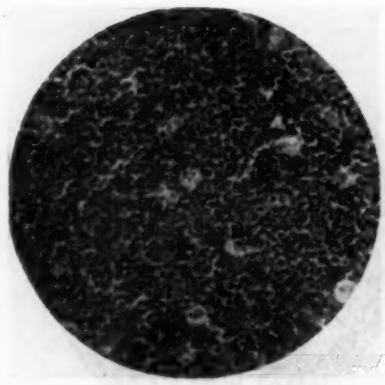

FIG. 7.—Schneiderian epithelioma—primary growth (a very cellular growth) often classified as a sarcoma.

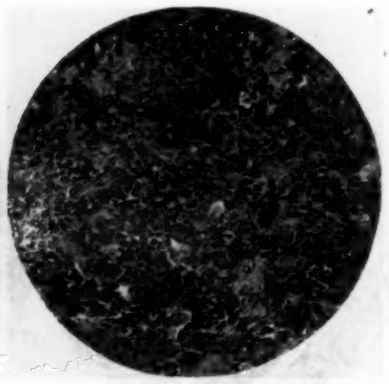

FIG. 8.—Schneiderian epithelioma, liver metastasis.

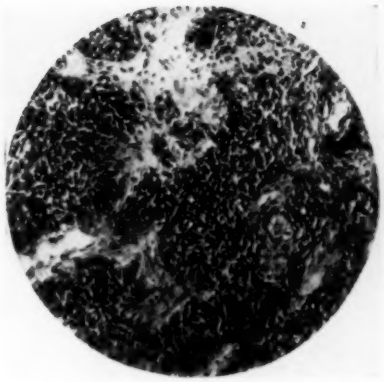

FIG. 9.—Epithelioma of the superior maxilla showing features of growths originating in the Schneiderian mucosa. In this tumor cylindrical-cell features are apparent.

FIG. 10.—Adamantina of the superior maxilla.

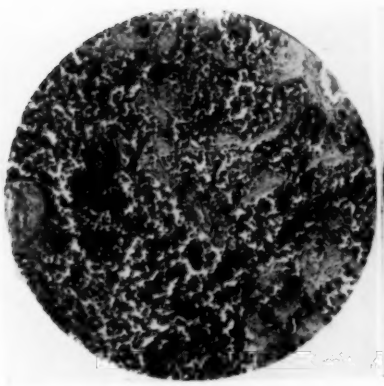

FIG. 11.—Embryonal epithelioma of the superior maxilla.

FIG. 12.—Embryonal epithelioma of the superior maxilla (from a metastasis).

The epithelial cells in both these varieties of epidermoid cancer are invasive.

The columnar cell type is as malignant as the squamous cell type and in no way resembles in its clinical course the basilar cell epitheliomas of the skin. In several of our cases the regional lymphatics were involved and the course of the disease was just as rapid as in the tumors atypically reproducing the more superficial cells of squamous epithelium.

The fourth form of epithelial cancer of the superior maxilla represents an atypical proliferation of cells characteristic of the Schneiderian mucosa. All those tumors classified as the nasal group have shown these characters.

They are all very cellular tumors with little tendency for the cells to be arranged in groups or columns, separated by connective tissue, the connective tissue elements being very scanty. The cells are polymorphous, preserving little of the form typical of any of the cells of the normal mucous membrane.

These tumors are by far the most malignant of all the tumors of the superior maxilla. Three of the four occurred in relatively young people, one in a young girl of seventeen, another in a man of twenty-eight, a third in a man of forty-eight, and the fourth in a man of sixty-two. The total course in the man of twenty-eight was only four months, and in the man of sixty-two, Hospital No. 24837, was five and a half months. This patient died in the hospital and a post-mortem was performed. His radium treatment had successfully eliminated the local disease, and though there were no involved regional lymphatics, the liver was studded with metastases, and the thoracic and abdominal lymph nodes invaded as low as the portal vein.

The cranium was not opened, but from the symptoms immediately preceding death, cerebral metastases were suspected. Figs. 7 and 8 show the structure of his tumor.

Figure 9 shows the structure of the tumor of the young girl of seventeen. It possesses a more organized morphology in which the cylindrical cells more characteristic of antral tumors are apparent. All four of these tumors not only filled the antrum and invaded the nasal cavity at the time they were referred to us for treatment, but in each case the orbit had also been invaded.

In at least three, the largest amount of the tumor was in the antrum, *i. e.*, this cavity seemed to be most extensively involved.

Adamantinomas, of which none of the superior maxilla have been treated during the past three years at the Memorial Hospital, form a special and fifth group of epitheliomas of the superior maxilla. Doctor L'Eperance has described eight of these growths, of which at least two were of the superior maxilla. They present a characteristic histology, and show no disposition to form metastasis, but a strong tendency like the basilar cell carcinomas of the skin to recur locally. Fig. 10 illustrates the structure typical of these growths.

Some of the growths of the superior maxilla show marked embryonal

features. We have met with a good example of one of these in a patient treated at the Memorial Hospital, but not in the radium department. The histology is so perfect that the accompanying reproduction (Fig. 11) has been added.

One patient of our series, Case No. 1, Hospital No. 21606, belongs most probably to this embryonal group. We are unable to reproduce a section of the primary tumor, but Fig. 12 shows the structure of one of the metastases. Her course is remarkable from both a pathological and clinical standpoint. Her clinical history is given with the other case-reports under the discussion of treatment.

Treatment.—In the treatment of carcinoma of the antrum, as is the case with the surgical treatment of cancer, our results bear a direct relation to the stage of the disease in which the patients come to us.

Those patients, who were treated in an early stage, while the disease was still small and localized to its primary seat, have given to date excellent results with radium alone. In those patients in whom the disease was still further advanced but yet well circumscribed, good results have been obtained by the use of radium, combined with a conservative operation which rendered the whole region involved more accessible to the radium. In the more advanced cases the same plan has given good temporary results, but none of these patients has been cured.

In an early growth still well circumscribed upon the alveolar border, even if it involves the adjacent portion of the cheek, a radium applicator can be made of dental modelling compound, which may be filled with filtered emanation tubes. We sink the tubes whenever possible to a depth of five mm., and distribute them as uniformly over the surface as possible, generally using enough tubes to make one tube for every 1 sq. cm., or 1¼ sq. cm.

Such an applicator may be held in the mouth of the patient for any reasonable length of time, one to four hours if necessary, and will cover the lesion accurately. For superficial lesions we use one-half mm. of silver as a filter. In deeper cases we use one mm. of platinum.

Whenever there is the slightest suspicion that the growth may have penetrated into the antrum—and it must not be forgotten that it often begins in the follicles of teeth which open into the antrum—or when we are dealing with a growth which is primary within the antrum, some operation must be performed which thoroughly exposes this cavity. I do not believe that anything is gained in those tumors primary in the antrum, or in the more advanced alveolar cases, which have invaded the antrum secondarily, by the disfiguring operation of resection of the whole of the superior maxilla through the usual incision of the Ferguson-Webber operation below the eye and along the side of the nose and through the lip; or by making a direct opening through the anterior wall of the antrum from the surface of the face. These operations seldom succeed in removing all the disease; so that, if an ultimate cure is to be expected, some other agent, as radium, must be depended upon. An operation which provides

good drainage to the antrum and enables the operator to expose the whole of the disease intimately to the radium is alone necessary. The removal of the superior alveolar process and sufficient of the adjacent portion of the hard palate, as may be necessary in case the nasal cavity has been invaded, accomplishes this purpose. This procedure can easily be accomplished, together with a preliminary ligation of both external carotids, under local anæsthesia. The neck work is done under infiltration anæsthesia and mouth work by induction anæsthesia, the emerging branches of second and third divisions of the fifth cranial nerve being easily reached by a long needle appropriately introduced below the malar bone. This operation gives excellent drainage and perfect exposure and, whenever it is unnecessary to invade the nose, very little inconvenience to the patient afterwards, as the opening fills in and contracts down in a most satisfactory manner. When it is necessary to remove enough of the hard palate to open the nasal cavity, a plate may be worn later.

The nasal cases must be managed differently. In all four patients of this series, the cavity of the orbit had been invaded. In order to obtain proper access in these cases, it is necessary to remove the eye, the orbital plate of the ethmoid and the floor of the orbit. This procedure gives complete exposure to the antrum, the orbital cavity and the nasal cavity.

Any temporary opening of these cavities by an incision beginning above the eye and along the side of the nose will surely be followed by disappointing results. Case I, K., Hospital No. 24837, was the only one of the nasal cases treated in this manner. This patient had a very malignant tumor and died afterwards of internal metastasis, but the local treatment was successful in causing a complete retrogression of the disease at its primary site.

Of the forty-three patients with carcinoma of the superior maxilla a complete retrogression to date has been obtained in eight. Only one of these eight patients has been traced to date. When last seen he was free from disease. On the other hand, there promises yet to be a favorable result in two other patients still under treatment.

The seven patients with complete retrogression traced to date form 16.2 per cent. of all the cases treated, many of which were advanced and wholly inoperable.

The time limit is, of course, an important factor. Only two of these patients are within a few months of the three-year period. The other five have passed a little over one year since their treatemnt was administered. Nevertheless, the presentation of this report at the present time, even though it must be considered a preliminary one, is justified for the following reasons: The majority of recurrences of cancer of the upper jaw take place within less than a year's time. A percentage of clinical cures to date of 16.2 per cent. in a series containing many advanced and inoperable cases promises a more favorable result by the method used than can be obtained by operation alone.

Scudder in his book on tumors of the jaws has collected the more important series of carcinomata of the upper jaw treated by operation alone up to 1912, and Tschistjokoff, in 1914, has published an additional statistical report of twenty-five cases. These series may be tabulated as follows:

Author	Source	No. of cases	Operative mortality	Cures
Martens	Ohlemann Kuster Birnbaum Braun Winiwarter Batzaroff von Petzold	49		2 (4 per cent.)
von Stein	Berlin Clinic	13		0
Fuchs	Breslau Clinic	23		0
Martens	Konig's Clinic at Göttingen	48	19	8(16.6 per cent.)
Martens	Gussenbauer Clinic	32		2 (6.2 per cent.)
Scudder	Massachusetts General Hospital	12	0	2 (16 per cent.)
Tschistjokoff *		25	7	None reported.

* (From *Chirurgia*, 1914, xxxv, 187. Reviewed in *Surgery, Gyn. and Obstet.*, 1914, xix, 590.

A comparison with these operative results supports the belief that the use of radium materially increases the therapeutic possibilities of cancer of the upper jaw and with far less risk.

In the article by Martens, Deutsche Zeitsch. für Chir., 1896-97, xliv, 483, the mortality of 124 cases operated on by Burns, Heyfelder, Ried, V. Langenbeck, Dumreicher, Esmarch, Beck, Bryk, Wilms, Simon, Billroth, Merkel, and König was 44, or 35.5 per cent.

In the most favorable cases the use of radium alone may produce a cure; it did so to date in two of our seven cases. In the more advanced cases it may cure when its use is combined with a less extensive and less disfiguring operation. It accomplished this result to date in three of our seven cases and in two others it produced a cure in growths recurrent after operation in other hospitals. There has been no immediate mortality among our cases and there should be no unfavorable results in the wise use of radium. Aside from overdosage in the primary treatment, which it is, of course, most important to avoid in all radium therapy, the next most important consideration is the avoidance of undue persistence in the treatment of those cases which have shown only a limited improvement after the first treatment. Many of these limited improvements mean much to the patient and it is, therefore, most tempting to continue their treatment; but nothing is of greater importance for the future comfort of those patients who cannot become cured than to recognize when all that is wise has been accomplished for them.

The following are the clinical records of the cases which have undergone a complete retrogression to date:

CASE I.—D. MacN., female, age thirty-four years, married, two children, Hospital No. 21606. Condition on admission, November 13, 1914: A small, flattened, rather soft, discoid-shaped prominence is present in the scar upon the right cheek, passing beneath the eye and down along the side of the nose. This scar is the usual one left after resection of the superior maxilla.

History.—In October, 1912, a tumor grew from the anterior wall of the antrum, producing a swelling on the cheek. An attempt was made to remove this by a local resection. It recurred, and in April, 1913, the attempt was repeated by resecting the anterior wall of the antrum. Later the lymphatic glands of the neck became enlarged, and in July, 1913, and again in September, 1913, all discoverable glands were excised. The above-described recurrence in the scar of the face was first noticed two weeks ago.

Pathological Examination.—Epidermoid carcinoma.

Treatment.—November 13, 1914, 25 mc. applied for fifteen hours in one plaque of rubber-covered lead 1 mm. thick. Following this treatment there was a rapid disappearance of the lesion.

February 13, 1917, no evidence of disease was present.

August, 1917, the patient was again admitted to the hospital with a large discoid swelling of the scalp over the left parietal bone. The tumor was very firm and hard, immovable, and measured 3 cm. by 6 cm., and elevated 2½ cm. Another similar tumor was present on the ulnar surface of the right forearm.

Treatment.—August 2, 1917, 391 mc. applied for twelve hours to the lower portion of the tumor on the scalp in 17 silver tubes ½ mm. thick inclosed in 1 mm. lead and distributed over an area of 35 sq. cm. at a distance of 4 cm.

August 3, 1917, 552 mc. applied for 14½ hours to the upper part of the tumor in the parietal region in 12 lead containers 2 mm. thick at a distance of 2 cm.

August 4, 1917, 456 mc. applied for 18 hours in 12 lead containers 2 mm. thick over the tumor of the forearm at a distance of 6 cm.

August 5, same treatment continued.

Ten hundred and two mc. applied over forearm for 10 hours in 12 lead containers 2 mm. thick at a distance of 6 cm.

All tumors disappeared after these treatments, and on March 1, 1918, there was no evidence of disease.

CASE II.—M. C., male, age sixty-five years, Hospital No. 22203. Condition on admission, July 1, 1915: An ulcerated mass of neoplastic tissue, presenting an irregular worm-eaten surface, involves the remnants of the external wall of the antrum, the inferior and internal walls of which have been previously resected. The growth involves the entire thickness of the tissues of the cheek, producing externally an ulcerated mass, one inch in diameter, and raised one-quarter of an inch.

History.—The growth was first noticed three and a half years before admission as a small ulcer upon the left upper alveolar process. Two years ago an attempt was made to completely remove it by a resection

of the alveolar process. He first noticed a recurrence two months ago, when there was fresh ulceration both inside the mouth and on the outside surface of the cheek.

Treatment.—July 6, 1915.—One hundred mc. applied inside the mouth for 12 hours in one rubber-covered tube of ½ mm. silver, and 75 mc., in one plaque of rubber-covered silver 1 mm. thick, applied over the ulcer on the cheek surface for 12 hours.

September 1, 1915, 100 mc. applied in one tube of rubber-covered silver 0.6 mm. thick, inside the mouth for 8 hours.

November 10, 1915, a progressive retrogression has taken place and, at present, no sign of his disease remains. It has been impossible to trace the patient since this time.

CASE III.—T. T., male, aged twenty-nine years, single, Hospital No. 22731. Condition on admission, August 11, 1915: An ulcerated nodular mass, 2 cm. in length, and 1 cm. in width, is growing from the anterior portion of the upper wall of the right antrum. The remaining walls of the antrum have been removed by operation about the middle of April, 1916.

Diagnosis.—Epidermoid carcinoma.

History.—In March, 1915, a swelling appeared external to the first molar tooth on the superior right alveolar process. This increased in size, and the superior maxilla was resected in April. The recurrence was noticed soon afterwards.

Treatment.—August 11, 1915, 100 mc. applied for 8 hours in one rubber-covered tube of 0.6 mm. silver.

September 1, 1915, marked retrogression.

September 25, 1915, 200 mc. applied in one rubber-covered plaque of 1 mm. silver for 6 hours.

November 16, 1915, a new ulcerated tumor has developed upon the internal surface of the inferior turbinate.

November 17, 1915, 75 mc. applied in three rubber-covered tubes to the new ulcer for 5 hours.

No recurrence has developed since this time.

CASE IV.—M. S., male, age forty-seven years. Hospital No. 23773. Condition on admission, September 24, 1916: Projection from superior right buccogingival groove is an egg-shaped mass, 3 by 2½ cm. in diameter. It is relatively soft and bleeds easily when traumatized. It produces a discoid prominence of the cheek over the antero-external wall of the antrum.

Diagnosis.—Epidermoid carcinoma.

History.—He first noticed the disease six weeks ago, and consulted a dentist, who pulled a tooth adjacent to the tumor. The three remaining teeth in the upper jaw are mere stumps. For years he has neglected his teeth, but they have never pained him. He is a heavy smoker (ten cigars a day). He denies syphilis. His general health has always been good.

Treatment.—September 24, 1916, 225 mc. applied for 6 hours upon the tumor in nine rubber-covered 1 mm. platinum tubes.

November 9, 1916, there is a complete disappearance of the ulcera-

tion and tumor mass inside the mouth. The swelling upon the face has been transferred into a flattened fluctuating prominence.

November 13, 1916, 540 mc. applied for 12 hours over the swelling on the cheek at a distance of 2 cm. in twelve lead tubes, 3 mm. thick.

November 27, 1916. Fearing invasion of the antrum, the superior alveolar process or floor of the antrum was removed. The cavity was found filled with tumor tissue.

December 19, 1916, 228 mc. applied for 2 hours within the antral cavity in six rubber-covered 1 mm. platinum tubes.

Following this treatment, there has been no return of the disease to date.

CASE V.—F. H., female, age forty years, married, seven children. Hospital No. 24423. Condition on admission, May 21, 1917: A scar left after a previous attempt to resect the superior maxilla is present beneath the right eye and along the side of the nose. Filling the angle between the eye and nose is a discoid prominence, 4 cm. in diameter. It is formed by the protrusion forward of the skin of the face by a tumor mass, which fills the remnants of the antral cavity and the right nasal cavity.

Enlarged lymph nodes are palpable on both sides of the neck.

History.—Thirteen years ago a swelling developed in the region of the right upper alveolar process. Two months later, the superior maxilla was resected. She remained well for ten years. Three years ago a recurrence developed. This was again removed by operation and she remained well until five months ago, when a recurrence again developed and progressively grew to the present size. Otherwise her previous health has been good.

Pathological Report.—Solid masses of epidermoid carcinoma, probably of dental origin, infiltrating edematous connective tissue.

Radium Treatment.—Seventy-five mc. in five unfiltered emanation tubes inserted into the substance of the tumor for fifty hours. At the end of this time, the tumor tissue was curetted out after ligating the left external carotid; the right external carotid was found to have been previously ligated. Following the operation, the patient ran a temperature for a couple of weeks.

Extensive sloughing followed the application, but this ceased and on November 9, 1917, no evidence of tumor tissue could be discovered.

CASE VI.—H. K., male, age sixty-six years, married. Condition when treated, May 9, 1917: In the roof of the mouth, between the middle line and the left superior alveolar process, the patient being edentulous, is a slightly elevated, hard ulcer with a nodular surface, and elevated hard, somewhat irregular edges. It measured 2¾ cm. by 2¼ cm. in diameter.

History.—The patient first noticed the present lesion six weeks ago. At that time, it was half the present size. A decayed tooth had been present for some time contiguous to the ulcer. These were extracted at this time.

Pathological Report.—Epidermoid carcinoma.

Radium Treatment.—One hundred ninety-two mc. applied for 3½ hours in eight 1 mm. rubber-covered platinum tubes.

June 20, 1917, retrogression almost complete.

August 17, 1917, retrogression complete.

March 8, 1918, no evidence of disease.

Case VII.—C. B., female, age thirty-seven years, single, Hospital No. 24516. Condition on admission, June 19, 1917: Small fistulous opening leads into left antrum through the canine fossa within the mouth. Around the mouth of this opening, upon the alveolar process, is an ulcer, the surface of which is covered with neoplastic nodules.

History.—In August, 1916, the patient had the left upper wisdom tooth extracted because of attacks of rheumatism. Six months ago (January, 1917) she developed pain in the left side of the face. At times this pain was referred to the upper jaw, and at other times to the lower jaw. A radiograph was taken, which disclosed an opacity in the left antrum. Eight weeks ago the pain became more severe, and two weeks ago the antrum was opened, and examination of the curettings showed carcinoma.

June 25, 1917, under general anæsthesia, the superior left alveolar process was removed, thoroughly exposing the antral cavity.

Radium Treatment.—July 6, 1917, 198 mc. applied for 2 hours in eleven ½ mm. silver tubes, embedded in a mold of dental compound.

Healing progressed satisfactorily and all local disease retrogressed, with no return to date.

Case VIII.—W. S., male, age fifty-seven years, married. Hospital No. 24738. Condition when admitted, September 1, 1917: On the left side of the roof of the mouth and alveolar process, and involving to a small extent the adjacent portion of the cheek, is a slightly raised growth, 2 cm. square. Its surface is irregular, nodular, and hard, but shows little ulceration.

History.—The present lesion was first noticed one year ago. It caused the patient no inconvenience until six months ago. He then consulted a dentist, who applied silver nitrate, and later a physician, who curetted the lesion. Following this treatment, it recurred and grew more rapidly. The patient has always smoked heavily, but attributes his disease to the irritation caused by poorly fitting artificial teeth. He denies venereal disease. His father died of cancer of the stomach.

Pathological Report.—Epidermoid carcinoma. No metastasis found in the lymph nodes subsequently resected.

Treatment.—September 1, 172 mc. in eight ½ mm. silver tubes, applied 1 mm. deep over an area of 12 sq. cm. in a mold of dental compound, 2 hours.

October 6, under local anæsthesia, the floor of the antrum was removed after ligating both external carotids. Considerable tumor tissue had invaded the cavity of the antrum; 415 mc. applied 1½ hours in nine ½ mm. silver tubes distributed over 15 sq. cm. of a mold of dental compound at a depth of 1 mm.

Following this treatment the lesion rapidly retrogressed, and at present there is no evidence of a recurrence.

Twenty patients were improved, but the improvement in the majority of them was only of short duration; although in many of them no evidence of disease could be found for a time. When recurrence develops in cancer of the antrum or nasal cavity, it progresses rapidly and only under exceptional circumstances is it wise to continue treatment. Six of these improved cases belonged to the alveolar or oral group, twelve to the antral group, and two to the nasal group.

The two following case-reports illustrate the character of improvement obtained in some of these cases. The first case belongs to the antral group, and the second to the nasal group:

CASE IX.—L. B., male, age forty-nine years, married, three children. Hospital No. 24388. Condition on admission, May 8, 1917: The left side of the face below the eye and zygoma as far down as the mouth is swollen to a height of 2½ cm. above the normal level of the cheek. The skin over the swelling is tense and somewhat reddened. Inside the mouth, in the left buccogingival fold, is a scar in the center of which is the opening of a sinus from which blood mixed with pus oozes.

History.—In the middle of February, 1917, he noticed some deterioration of his general health. In the middle of March he began to feel pain in his face. An attempt was made to relieve this by the extraction of a tooth. Soon after this the face became swollen and the pain became more severe. Toward the end of March a growth was noticed in the left nasal cavity. His previous health has been good with the exception of frequent attacks of biliousness. He denies venereal infection.

Pathological Examination.—A compact, very cellular, epidermoid carcinoma.

May 9, 1917, under local anæsthesia, both carotids were ligated, and the floor and lateral walls of the antrum removed.

May 14, 1917, radium treatment.

Three hundred four mc. in sixteen 1 mm. platinum tubes applied within the antral cavity, 2 hours.

June 8, no evidence of disease could be discovered.

November 14, a recurrence discovered.

November 24, radium treatment.

One hundred two mc. in ½ mm. silver upon the surface of a dental mold of an area 4.5 sq. cm. applied to the interior of the antrum 3 hours.

December 28, only a slight improvement in the cavity of the antrum, and recurrence of tumor in the tissues of the cheek.

January 3, 1918, two bare emanation tubes of 7.4 mc. each inserted into the recurrence in the cheek.

March 15, he reports that the tumefaction in the cheek has disappeared, but that his eye is beginning to protrude. Further treatment deemed inadvisable.

CASE X.—J. K., male, age sixty-two years. Hospital No. 24837.

Condition on admission, October 10, 1917: The right eye protrudes forward in exophthalmos (11 mm.). There is considerable chemosis of the conjunctiva. Through the anterior naris a mass can be seen which is apparently invading the right nasal cavity from its external wall. No enlarged glands are palpable in the neck.

History.—Seven to eight weeks ago the right eye began to "water." He attributed the trouble to an inflammation of the eye, and it was severe enough for him to consult a physician. No evidence of the presence of a new growth was discovered. Five weeks ago he first noticed the development of exophthalmos. Four weeks ago he went to Bellevue Hospital, and a week later the eye became blind. The sight of the left eye is unimpaired. He smokes only moderately. States that he had gonorrhœa and a chancre forty years ago. For the syphilis he received treatment for only a short period.

Pathological Report.—One fragment removed from the nose. Inflamed cellular carcinoma arising, probably, from transitional epithelium. Later another report from tissue removed at operation.

Solid cellular highly anaplastic carcinoma, containing a few small pearls.

October 20, 1917, operation under local anæsthesia, later supplemented by ether. The external carotid was ligated, and the eye enucleated, and all the new growth within it removed. This involved the removal of the floor of the orbit and the lateral wall of the nose, as the new growths had invaded the antrum and nasal cavity.

Radium Treatment.—Two hundred and sixty-five mc. applied to the interior cavity left by the operation in five 1 mm. rubber-covered platinum tubes for 8 hours. Following this treatment, the cavity healed smoothly, and at no time afterwards was there any evidence of new growth remaining within it.

On December 28, 1917, the patient became very restless, and later irrational, and finally passed into coma. He died January 1, 1918.

Autopsy (January 1, 1918).—*Heart*: Size, chambers, muscles normal, all valves slightly thickened and soft. Atheroma in the aorta extensive. *Lungs*: Congested. Beginning consolidation in the right lower lobe. There are numerous miliary and larger opaque tumors in the parenchyma of both lungs. Intense bronchitis. *Spleen*: Large, soft, and congested. *Liver:* Very much enlarged, uniformly studded with tumor nodules miliary to the size of a marble. Portal nodes much enlarged with tumor tissue. Other abdominal organs normal. Thoracic and abdominal lymph nodes involved as low as, but not beneath, the portal vein. The lymph nodes of the neck are free from carcinoma.

Of the remaining patients, ten were unimproved, and four are still under treatment.

Five of the unimproved patients belong to the alveolar group, and three to the antral group, and two to the nasal group.

THE OPERATIVE TREATMENT OF TRIFACIAL NEURALGIA

By William Sharpe, M.D.
of New York
Professor of Neurological Surgery in the New York Polyclinic Medical School and Hospital

There is no pain quite so severe, agonizing and at the same time comparatively so intangible as that of neuralgia of the trifacial or trigeminal nerve, the so-called "tic douloureux." In the milder cases, however, the pain may be so intermittent that a number of days or even weeks and months may elapse without there being even a sensitive twinge, and then again, in the more severe cases, the pain may be practically continuous, always associated with spasmodic facial contractions; these latter cases are usually the end-results of the former milder ones, upon whom every known medical treatment has been used, and only too frequently with little or no success.

True trifacial neuralgia rarely occurs in people under forty years of age; in fact, those cases developing under fifty years of age should be most carefully examined, especially regarding the incidence and character of the attacks and whether associated with facial spasm; a mistaken diagnosis can be very easily made—hysteregenetic pain possibly being the most frequently confused, while neuritis of the systemic type or due to a local irritation, such as dental lesion and a latent sinusitis, particularly of the homolateral antrum, should be most carefully excluded before the final diagnosis of trifacial neuralgia is confirmed.

The pathology of trifacial neuralgia is still obscured; in the majority of the patients, no lesion of the trifacial nerve or of its Gasserian ganglion (*vide* Fig. 1) can be ascertained; in some of the specimens there were indeed neuritic changes, particularly an increase of the connective tissue with an abundant vascularity, but I feel that these changes in many of the severe cases requiring finally the ganglion operation are more the result of the former treatment, especially the injection of alcohol into the peripheral branches with a resulting ascending neuritis even into the Gasserian ganglion itself, rather than being primarily due to the condition itself. No doubt carious teeth with root abscesses and sinus infections may originally be factors in predisposing to trifacial neuralgia, but in my series of patients, it seems that these dental and sinus lesions were but incidental and not in any way etiological factors. In almost all of my patients upon whom the major operation of evulsion of the posterior sensory root or a removal of the Gasserian ganglion had to be performed, the history of the former treatment in addition to the routine medical measures was practically the same; that is, if the pain began in either the upper jaw supplied by the second peripheral branch of the trifacial nerve or in the lower jaw supplied by the third peripheral branch, then in each patient the adjacent teeth were extracted, and if the pain did not subside, then a peripheral nerve resection,

alcoholic injection, and, finally, in a small number of patients, even an attempt to inject alcohol into the Gasserian ganglion—a medieval method similar to the former blind aspiration of the gall-bladder and distinctly more dangerous; the alcoholic injection of the Gasserian ganglion cannot be too strongly condemned, as it is, in my opinion, of greater danger to the life of the patient and the probability of serious complications so much graver than the major operation itself; to insert a needle blindly (as the measurement and angle of each cranium widely vary) through the foramen ovale into only the Gasserian ganglion and then to force alcohol into the ganglion and nowhere else—such as the adjacent subdural spaces, cavernous sinus, carotid artery, *et cætera* (and those complications have been reported), is distinctly a much greater risk than the major operation itself.

In the diagnosis and treatment of patients having true trifacial neuralgia, the greatest care must be used and all the modern methods utilized, first, in order to ascertain the true condition, and, second, if the condition is undoubtedly trifacial neuralgia, then the application of the palliative expectant treatment in its various forms in the hope that the condition can be improved, if not permanently relieved; this happy result can be obtained in a small percentage of patients having true trifacial neuralgia. Naturally, the major operation should not in any case be advised until it is proved beyond a doubt that the milder methods of treatment are of no real benefit to the patient—becoming more and more physically and nervously exhausted. Morphia, in any of its various forms, should not be administered to these patients; it frequently happens that the combat against the morphia habit must be started immediately after the major operation, and sometimes without lasting success.

Most important diagnostic aids in excluding the common local causes of a peripheral facial neuritis are röntgenograms of the teeth and the osseous dental canals; of the sinuses, particularly the ipsolateral antrum and frontal sinus (to be further confirmed by transillumination), and then, affected much more infrequently, of the contiguous facial bones and even of the bones adjacent to the foramina at the base of the skull, especially the greater wings of the sphenoid and also the petrous portion of the temporal bone; in this latter connection I shall discuss more in detail, at the end of this paper, the probability of an exostosis pressing upon the Gasserian ganglion as a possible etiological factor in some patients. I have yet to see a patient having a true bilateral trifacial neuralgia; I feel that if a patient complains of pain in both sides of the face then the patient is not suffering from true trifacial neuralgia—the cause of the neuritis being rather a general systemic one, or a bilateral local lesion of the teeth or of the sinuses; visual impairments may also be a factor in those bilateral pains; the associated gastric disturbances usually indicate a migrainous condition.

A source of local irritation and infection is undoubtedly present in a large number of so-called cases of trifacial neuralgia—in reality, however, a condition of neuritis; the teeth are most frequently involved and then possibly the sinuses; syphilis must always be excluded, also malignant

growths at the base of the skull adjacent to the foramina of the peripheral trifacial branches. Naturally, the appropriate treatment is advisable according to the local lesion found, but, as frequently happens in the true cases of trifacial neuralgia, no local or general cause for the pain can be ascertained, and it is in these latter patients that it is absurd to extract normal teeth, and to perform the various sinus operations in the belief and the hope that the pain will then subside; naturally, if there is a definite dental or sinus lesion, then that condition should be removed, but to perform dental and sinus operations when no lesion can be demonstrated and only in the hope that "good may come from them" is not creditable either to modern surgery or to the specialist himself.

In the typical cases of true trifacial neuralgia, there can be ascertained no local source for the irritation of the peripheral nerve branches. All of these patients, however, should be given a course of systemic treatment, diet and appropriate medicine, in the hope that the pain may possibly be lessened; the local applications of heat, cold, salves, electricity, diathermia and whatever means may be considered of possible benefit. They usually fail, but still I feel that they should be given a thorough trial: if successful, excellent, and if they fail then no real harm has been done except of continuous and prolonged pain upon the general condition of the patient. This treatment, however, should not be continued longer than from three to six months, and if no definite relief has been obtained within that period of time, then, if only the area of the face supplied by one trifacial nerve branch is involved, the question of injecting alcohol into the peripheral branch, or even its peripheral evulsion and possible removal, may be considered.

It should be remembered in this connection that many patients having true trifacial neuralgia suffer very intermittently in the beginning of the condition and this initial mild stage may continue for two or more years. For this reason, some local remedies have been undeservedly eulogized merely because the pain happened to cease within a few days or even weeks during their application. I have yet to see, however, a true case of severe trifacial neuralgia of its three branches amenable for any length of time to any kind of treatment other than the successful alcoholic injection of the individual branches, their resection or evulsion and the major operation itself upon the Gasserian ganglion. The methods of alcoholic injections (*vide* Fig. 2) and of resections of the peripheral branches are naturally of only temporary benefit—the pain usually returning within one year. The longest period of relief obtained by either of these procedures in any of my patients was nine months, whereas the major operation upon the Gasserian ganglion results in the permanent relief from all pain in the area supplied by the affected trifacial nerve.

If all three branches of the trifacial nerve are involved, then it is of little benefit to attempt to remove the pain by the injection of alcohol into the individual branches. Not only does it require frequent injections, but the pain in such patients is rarely relieved—one branch or the other being

continuously affected; besides, it seems that the frequent use of alcohol causes in some patients an ascending neuritis to occur so that apparently the Gasserian ganglion itself may be thus involved. Naturally, when this does occur, and it may even result from injecting alcohol in one branch only, then severe pain appears in all of the branches and no relief can be obtained by any of the peripheral procedures since the nerve irritation in or about the ganglion is central to the peripheral injection of alcohol, nerve resections, and nerve evulsions; the major operation upon the ganglion is now the last hope of relief. I still use alcohol for peripheral injection in all patients having only one branch affected, preferably the second or third branches, but if both these two nerves are continuously affected and of great severity, then I do not hesitate to advise the major operation as a sure means of immediate relief and an operative procedure to which all of these patients must eventually come—but only too frequently in a greatly exhausted condition entailing much needless suffering due to the unwise delay.

The resection of a peripheral branch, and, better still, its evulsion at the distal foramen of exit, can be advocated in selected cases after the failure of alcoholic injections to influence the pain when one branch is affected, and even when two branches are involved, but to advise these peripheral operations when all three branches are causing severe pain or after the positive injection of alcohol in the nerve itself has definitely proved that the nerve irritation is central to the peripheral branch external to the foramina—in these latter cases it is distinctly foolhardy to expect nerve resections or even evulsions to cause a cessation of the pain; in these patients, nothing but the ganglion operation will suffice. If, however, a peripheral resection is considered advisable or, better still, an evulsion of as large a portion of the branch as can be wound about dissecting forceps (usually one to two inches), then by no means should the incision be made on the outside of the face but rather inside of the mouth with retraction of the cheek muscles for both the second and third branches, and only at the supra-orbital notch need a small external slit in the skin be made to permit an evulsion of the first branch; novocaine usually suffices. The surgical mutilation by external operations upon the faces of these unfortunates is notorious and can no longer be defended.

The majority of patients having the condition of true trifacial neuralgia have, as a rule, passed through these various stages of treatments so that I have been spared the unsatisfactory use of them. I must also state in this connection that hysterical facial pain has frequently been mistaken for trifacial neuralgia and naturally the peripheral alcoholic injections and nerve resections have been of no benefit to the patients; and it does seem that dental and sinus lesions may be the forerunners of certain cases of true trifacial neuralgia—at least the reports from the dental and sinus operations would indicate a pathological process of varying degrees in many of the patients.

We now come to that large class of patients having finally, at least, the condition of true trifacial neuralgia--whatever the antecedent history—

and all medical treatment and peripheral nerve operations have failed. What now is the best means of assuring relief to the patient? There remains no doubt regarding the advisability for these patients of the operation upon the Gasserian ganglion—and better still, the evulsion of the ganglion's posterior sensory root from its origin in the pons; with the ganglion exposed, this can be very easily performed by means of a small blunt hook about the sensory root just posterior to the ganglion and a gentle traction made outward so that the torn end of the root can be pulled forward and exposed over the ganglion. In this manner the motor branch is usually spared and the former difficulty of extirpating and removing the ganglion itself is thus avoided; this operation of evulsion of the sensory root is the operation of choice and by it a permanent relief of pain can be assured to the patient.

A number of operative routes have been devised to approach the ganglion itself. The former osteoplastic flap operation of Hartley-Krause is now no longer used; by it not only was a large bone flap turned down with a consequent large amount of blood lost, but by its being higher on the side of the skull it was necessary to retract the brain upward strongly in order to obtain a good exposure of the ganglion and thus the danger of cerebral complications was to be feared.

The operation as devised by Cushing is in many respects undoubtedly the best operative method in that it approaches the ganglion through a small bony opening at the side of the base of the skull—the lower angle of the bony opening being made on a level with the ganglion itself; in this manner, the retraction upward of the overlying dura and adjacent brain is the minimum necessary to obtain an excellent exposure of the ganglion and its sensory root; the loss of blood is comparatively slight and the operative difficulties, if encountered, can be readily dealt with through this opening; in fact, in this operation the larger the opening the greater danger of operative complications. Following the method of Cushing, the anæsthetic is administered and the operation is performed with the patient in the usually horizontal position—the head slightly elevated, but the patient not in a sitting or reclining position; this latter posture is undoubtedly an excellent one for an operator accustomed to it and it is claimed that the hæmostasis is more easily obtained.

The best operative exposure is obtained through a small curved incision of about 5 cm. in length extending from a point at the upper border of the zygomatic process and about 2 cm. anterior to the external auditory meatus (*vide* Fig. 3); the incision curves upward and forward until it approaches within 2 cm. of the external orbital rim and no farther for fear of injuring the frontal branch of the facial nerve with a resulting paralysis of one-half of the frontalis muscle—a very noticeable deformity. This incision extends through the skin and subcutaneous tissues down to the temporal fascia; small curved hæmostats are applied to the subcutaneous fascia and, as the same method of manual pressure-traction is used as in the operation of subtemporal decompression, the loss of blood is so minimized that it is practically *nil*.

A curved incision is now made, parallel with the skin incision, through the temporal fascia and its underlying temporal muscle down to the bone, and two small curved retractors quickly inserted both to control the loss of blood and to enlarge the exposure (*vide* Fig. 4); the zygomatic process is not resected and it is not necessary to remove it in order to obtain a better exposure unless the skull and face of the patient are unusually broad. I have been obliged to resect the zygoma in only one patient.

To open the skull, and then to enlarge the bony opening, the same technic is used as in the operation of subtemporal decompression [1] (*vide* Fig. 5), that is, the Doyen perforator and burr are used to penetrate the thin portion of the exposed bone down to the dura and then this small bony opening is enlarged by rongeurs, and especially downward to the base of the skull as far as possible, to a size slightly larger than a one-half dollar piece—usually about 3 cm. in diameter. With efficient retraction this bony opening permits an excellent exposure of the Gasserian ganglion and any possible operative complications can be properly controlled through it; not only is any operative deformity thus avoided (the non-removal of the zygomatic process being a most important factor in this regard), but a careful hæmostasis is much more easily obtained and thus the necessity of a second-stage operation is rarely obligatory.

A special dural spatula-retractor of the width of 1.5 cm. is now inserted downward and forward between the bone and the dura (*vide* Fig. 6). Care must be taken not to tear the middle meningeal artery in its dural course and thus avoid the complication of troublesome hemorrhage; the dura should be gently separated from the bone and what little oozing of blood occurring can be well controlled by small cotton pledgets wet in warm normal saline solution. The operator must not be in a hurry and impatient if slight delays occur—otherwise the danger of complications is much greater. I know of no operation that requires more patience and is such an excellent test of the operator's self-control, as well as the assistants' and nurses', than this ganglion operation; everything must "go smoothly," and if it should not, then it is necessary for the entire team to make it possible; the patient alone suffers when the operative technic is not most efficient. Continuous firm retraction is essential; the almost continuous use of small cotton pledgets (the size of a ten-cent piece) is necessary to keep the ganglion field as dry as possible so that the second and third branches can be clearly seen and thus make possible a perfect orientation.

For fear of complications it is always wise to expose the second branch as it enters the foramen rotundum; then by moving the retractor slightly backward, the third branch can be seen rising from the foramen ovale just anterior to the foramen spinosum through which the middle meningeal artery passes to attach itself to the dura. Where the second and third branches converge within the outer layer of the dura, there we know lies the Gasserian ganglion.

[1] *American Journal of the Medical Sciences*, April, 1915, No. 4, vol. cxlix, p. 563.

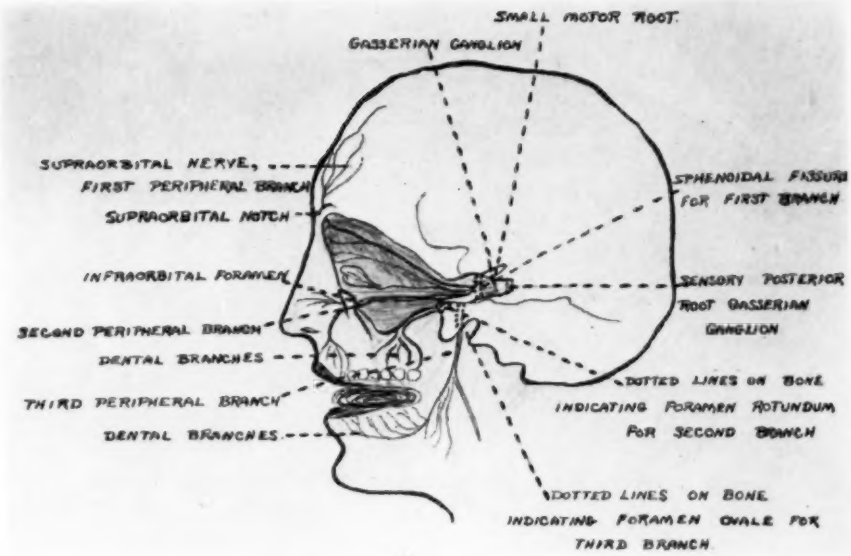
SMALL MOTOR ROOT
GASSERIAN GANGLION
SUPRAORBITAL NERVE, FIRST PERIPHERAL BRANCH
SUPRAORBITAL NOTCH
SPHENOIDAL FISSURE FOR FIRST BRANCH
INFRAORBITAL FORAMEN
SENSORY POSTERIOR ROOT GASSERIAN GANGLION
SECOND PERIPHERAL BRANCH
DENTAL BRANCHES
DOTTED LINES ON BONE INDICATING FORAMEN ROTUNDUM FOR SECOND BRANCH
THIRD PERIPHERAL BRANCH
DENTAL BRANCHES
DOTTED LINES ON BONE INDICATING FORAMEN OVALE FOR THIRD BRANCH

FIG. 1.—Sagittal section of Gasserian ganglion, showing its peripheral branches, their foramina of exit and their distribution.

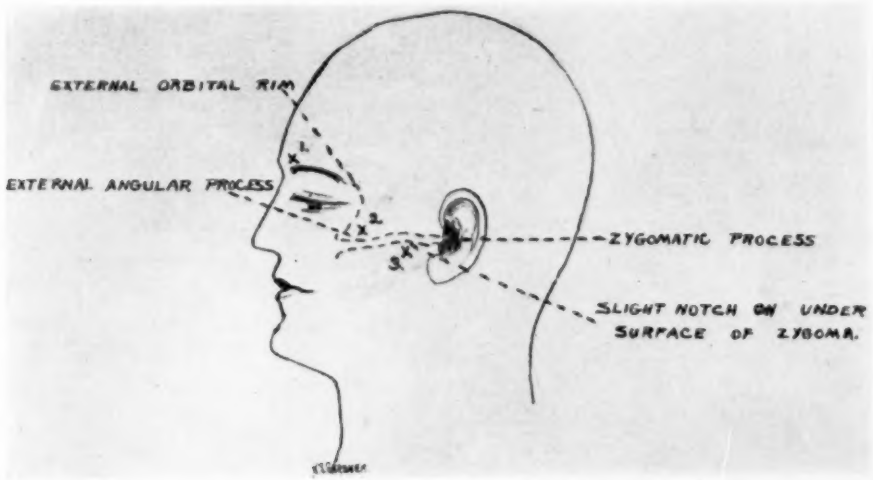

FIG. 2.—Points of election for alcoholic injections of the trifacial nerve. 1, point for injecting the first branch in the supra-orbital notch. 2, point just above zygoma and posterior to the external process for injecting the second branch; needle to be inclined forward and downward. 3, point just below inferior notch of zygoma for injecting third branch; needle to be inclined backward and upward.

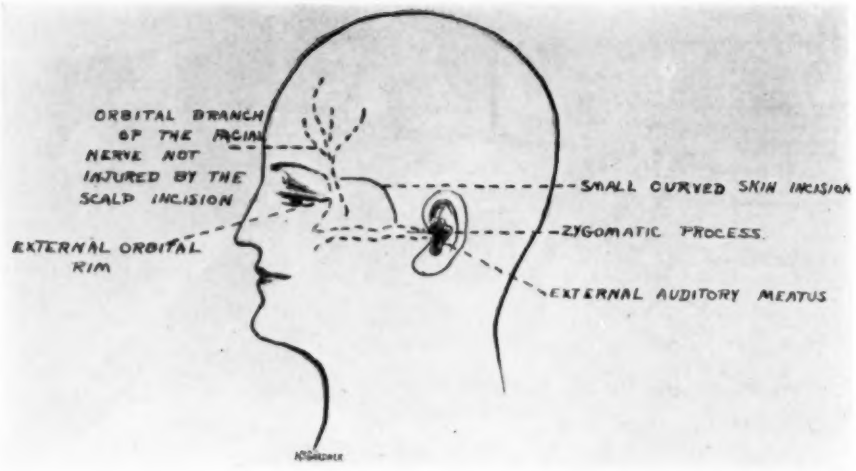
ORBITAL BRANCH OF THE FACIAL NERVE NOT INJURED BY THE SCALP INCISION
EXTERNAL ORBITAL RIM
SMALL CURVED SKIN INCISION
ZYGOMATIC PROCESS
EXTERNAL AUDITORY MEATUS

FIG. 3.—Small curved scalp incision from upper border of zygomatic process and about one inch anterior to the external auditory meatus upward and forward to within three-quarters inch of the external orbital margin—thus sparing the orbital branch of the facial nerve.

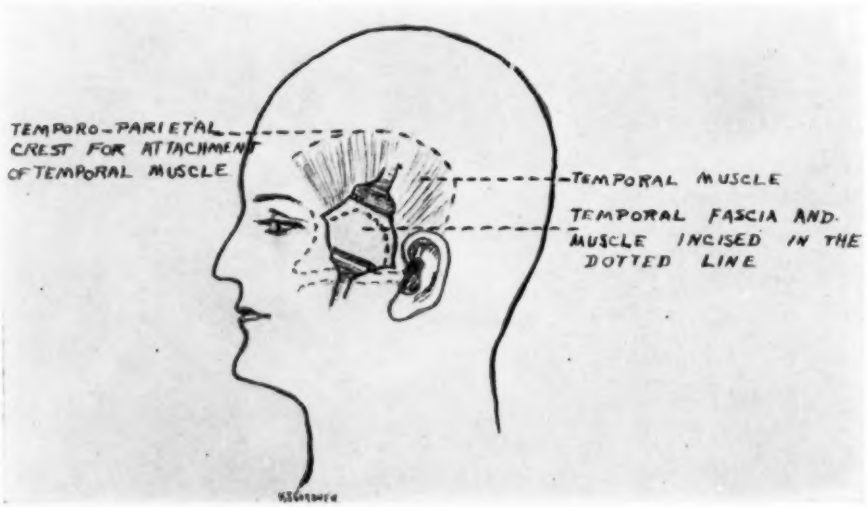
TEMPORO-PARIETAL CREST FOR ATTACHMENT OF TEMPORAL MUSCLE
TEMPORAL MUSCLE
TEMPORAL FASCIA AND MUSCLE INCISED IN THE DOTTED LINE

FIG. 4.—Showing the scalp retracted and the dotted curved incision through the temporal fascia and muscle. Relation of incision to the temporal muscle is indicated diagrammatically.

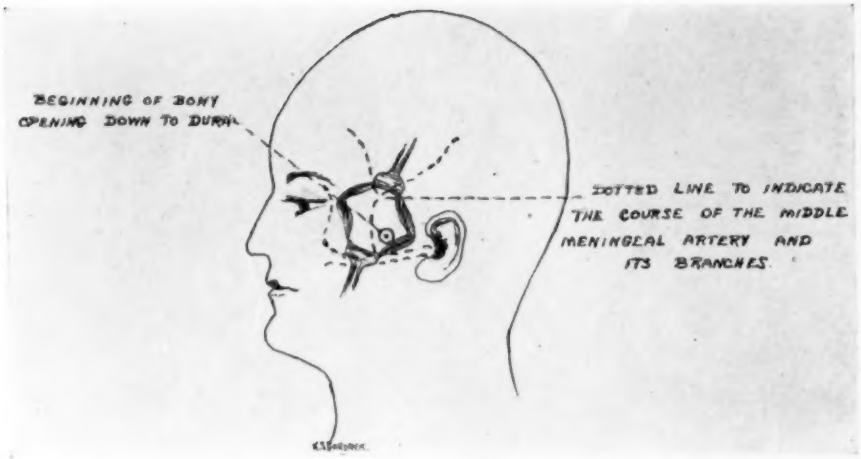

FIG. 5.—Showing scalp, temporal fascia, and muscle retracted with pin-point opening of the bone down to the dura made by the Doyen perforator and burr; bony opening enlarged by rongeurs; dura is never opened.

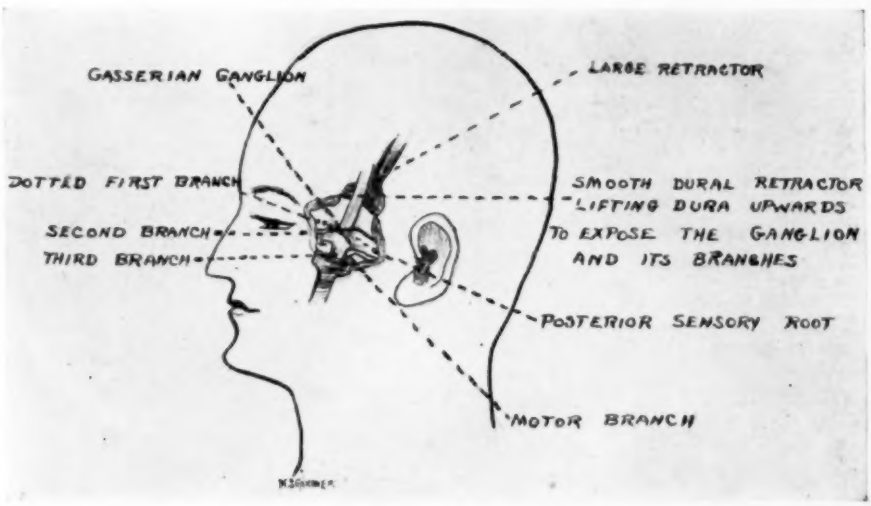

FIG. 6.—Schematic view—only the outer layer of dura over ganglion incised and retracted upward, exposing the Gasserian ganglion, its three peripheral branches, the posterior sensory root and the motor branch. Small curved blunted hook used to evulse the posterior sensory root from its origin in the pons.

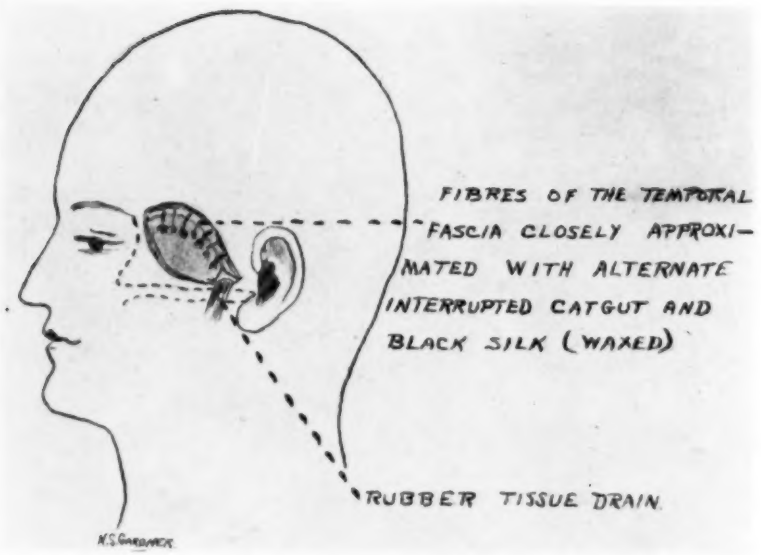

FIG. 7.—Closure of operative incision; a rubber tissue drain inserted at lower angle down to site of ganglion at base; temporal muscle approximated closely by interrupted catgut sutures then temporal fascia sutured as above.

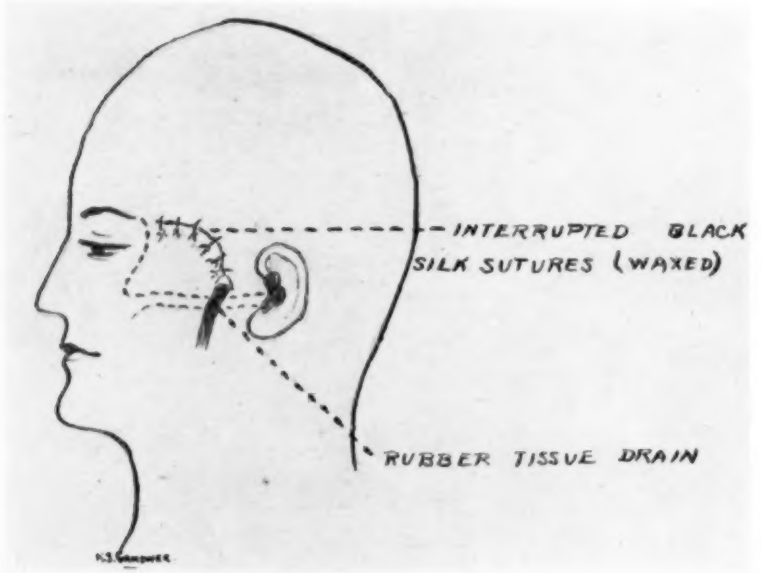

FIG. 8.—Scalp closure with fine black interrupted silk sutures (waxed). Rubber tissue drain to remain *in situ* for twelve hours.

FIG. 9.—Gauze roller bandage applied and held firmly by adhesive strips. The homolateral eye not covered but the surrounding external angular process is carefully sealed by the bandage.

As the outer layer of the dura must now be incised just over and slightly posterior to the ganglion, it is frequently advisable to apply a silver clip to the middle meningeal artery just above the foramen spinosum so that there will be no danger of an annoying hemorrhage if the vessel should be torn. As a rule, however, I attempt the ganglion operation without this precaution, and then if arterial bleeding should occur, the vessel itself can be ligated after a delay of several minutes; the pressure of small cotton pledgets usually suffices.

Upon incising the outer layer of the dura overlying the ganglion, the pointed nose of the retractor is slipped into the dural pocket of the ganglion so that an excellent exposure of the ganglion and the posterior root is obtained. Troublesome venous oozing may delay a good exposure of the posterior root, but if patience and the continuous use of small cotton pledgets are persevered in, then these difficulties are usually overcome. When the posterior root can be seen accurately, then a small blunt hook can be safely passed about it posterior to the ganglion, and with gentle traction the root itself can be evulsed from its origin in the pons so that the torn end is seen pulled forward over the ganglion. It is usually possible to spare the motor branch—but not always. If after repeated efforts a good view cannot be obtained of the posterior sensory root as it enters the posterior portion of the ganglion on account of dural adhesions or troublesome oozing of blood, it is then advisable to remove the ganglion itself rather than to attempt to evulse the sensory root blindly and possibly not succeed. In all cases of doubtful evulsion of the sensory root, the ganglion should always be removed in order to be absolutely sure of its destruction. The overlying outer layer of the dura can be widely opened so that the entire ganglion is exposed lying in its dural bed, and after it has been freed of its adhesions by means of a small blunt dural separator, the ganglion itself can be pulled forward; frequently the posterior sensory root is evulsed by this procedure, but if there is any doubt of it at all, then the ganglion can be severed from its peripheral branches and removed in one piece or in fragments. The oozing of blood is always much greater in this method than if the posterior sensory root can be evulsed. Cotton pledgets wet in warm saline solution soon control the bleeding so that the closure can be made within a few minutes after the extirpation of the ganglion. After a rubber tissue drain is inserted to the bed of the ganglion (to be removed at the end of the operation), the dural retractor is withdrawn so that the dura now rises to its normal position and thus compresses any small dural vessels that may have been torn. There being little or no bleeding, the fibres of the temporal muscle are sutured with interrupted catgut and then the overlying temporal fascia with alternate interrupted catgut and fine black silk sutures (waxed) (*vide* Fig. 7); a firm closure is thus obtained. Interrupted catgut sutures are used for the subcutaneous tissue (*vide* Fig. 8), while interrupted fine black silk sutures may be used for the skin (*vide* Fig. 9). The drain of rubber tissue is now removed, unless there is some oozing of

blood; if so, then the drain is allowed to remain until the first dressing, which is the following day; the second dressing occurs on the sixth day post-operative and all sutures are then removed; the patient is allowed to sit up and is usually discharged about the tenth or twelfth day.

No protection of glass or gauze dressing is placed over the ipsolateral eye to prevent serious corneal complications in the belief that these measures merely tend to increase the danger of such irritations to an insensitive cornea; the patient is instructed before the operation about the danger of rubbing the eye; during the recovery from the anæsthesia the patient is carefully watched so that the eye itself is not touched, and then when the patient regains complete consciousness the eye is not treated at all—not even washed out with boracic acid solutions. In several of my earlier patients small corneal ulcerations appeared, due, as I now believe, to using protective coverings for the eye instead of letting the eye entirely alone—not touching or rubbing it either by hand or by a so-called protection. The instruction of the patient is possibly the most effective method of avoiding such complications.

In three patients upon whom I attempted the ganglion operation, I encountered such operative difficulties, particularly a general oozing of blood so continuously obscuring the ganglion, that I was obliged to finish the operation at a later date. These cases are rare and usually occur in patients having had a large number of alcoholic injections, which apparently increase very much both the vascularity and the adhesions about the ganglion.

In two patients, malignant disease at the base about the foramina of exit of the second and third branches made the ganglion operation impossible, so that the second and third branches alone were severed. This intracranial sectioning of the peripheral branches of the trifacial nerve is naturally only a temporary palliative measure; with few exceptions it should never be performed, and it is by no means the operation upon the Gasserian ganglion; it seems that some operators believe this is the major operation itself and merely perform upon patients this temporary procedure; naturally, the pain returns within a year as a rule.

It may be a coincidence, but my last three patients have each had a definite bony protuberance arising from the upper portion of the anterior surface of the petrous bone and extending apparently into the outer edge of the Gasserian ganglion, so that in order to approach the ganglion it was necessary to use a small chisel to remove the bony obstruction; at its inner side lay the ganglion. This bony process or possibly exostosis has been observed in several other patients and it may possibly be a factor in producing the condition of trifacial neuralgia which is always unilateral; the irritation of the ganglion by its direct or indirect pressure may be a primary cause of the conditions; it is significant in these last three patients, the pain originally began not in one branch but in two or three branches. This condition of a possible exostosis as a primary cause of some cases of trifacial neuralgia should, I feel, be considered.

A NOTE ON THE SURGICAL TREATMENT OF CERTAIN DISEASES BY SPLENECTOMY

By James Sherren, F.R.C.S. (Eng.)
of London
surgeon to the london hospital

In a recent number[1] of the Annals of Surgery a paper by Balfour appeared recording a case of splenectomy for repeated gastro-intestinal hemorrhages. Shortly after reading it I received information of the sudden death of one of my patients from profuse hæmatemesis thirteen months after splenectomy had been undertaken for this reason. In view of this I thought it would be of interest to publish the case in full with notes of others in which hemorrhage has been a prominent factor.

I have carried out 14 splenectomies for disease, with one death—a boy of fourteen on whom it was performed for advanced cirrhosis of the liver. He had been ill five months with ascites and œdema of legs. At the request of the physician under whose care he came I decided to operate. There was marked œdema of legs and scrotum and fluid in the right pleural cavity. Wassermann examination negative. The operation presented no difficulties and the spleen, which weighed 17 ounces, was not adherent. He died forty-eight hours later.

The remaining cases were distributed as follows: Splenic anæmia and Banti's disease, 9; Gaucher's splenomegaly, 1; hydatid cyst of spleen, 1; splenomegalic jaundice, 2.

In three of the first group gastro-intestinal hemorrhage caused the patient to seek medical advice; two had been under treatment previously, diagnosed gastric ulcer.

The first was a male of twenty-seven whom I operated upon on February 27, 1914. Until June, 1911, he was, so far as he was aware, well, except for occasional epileptic fits. He then had a profuse attack of melæna. A year later he had a further severe attack followed by several slighter ones. A month before I saw him the diagnosis of Banti's disease was made by his medical adviser, Dr. Cuthbert Ede, by whom he was sent to Dr. Robert Hutchison and to Sir William Osler. The following is the latter's letter and two blood counts:

Feb. 16, 1914: I enclose you the blood count—very typical. I return you the other. The two things of importance are (1) the prognosis—the ultimate outlook is bad. Hemorrhages recur, with or without attacks of anæmia. (2) As to the treatment. Nothing that I know has any influence on permanently reducing the spleen. The removal of the spleen is followed by permanent cure. Operation, of course, is not without risk. The results depend very much upon the

[1] Annals of Surgery, 1917, lxv, 89-94.

surgeon, but nowadays the mortality from the operation is becoming less and less. I do not think the *petit mal* would contraindicate in any way the operation.

January 20, 1914: *Differential count*: Polymorphonuclears, 65 per cent.; monomorphonuclears, 30 per cent.; transitionals, 3 per cent.; eosinophiles, 2 per cent. The leucocytes are few in number, from which one infers that there is a leucopenia. The red blood-cells show no abnormality in size, shape or staining reactions. The blood picture, in view of the clinical facts given, is compatible with a diagnosis of splenic anæmia in an early stage.

February 15, 1914: Red cells, 5,100,000 per cmm. hæmoglobin, 85 per cent.; color index, .8; leucocytes, 3750.

Differential count: Neutrophiles, 74 per cent.; small lymphocytes, 7.5 per cent.; large lymphocytes, 12.5 per cent.; large mononuclear, 3.0 per cent.; eosinophiles, 2.5 per cent.; mast cells, .5 per cent. The red cells are regular in size, shape and staining reactions. No nucleated red cells and no myelocytes were seen. The films show a marked scarcity of white cells.

Operation was difficult, as there were many adhesions of the upper pole. The liver was perhaps a little harder than normal, but there were no definite signs of cirrhosis. Stomach and gall-bladder normal. The spleen weighed 2 pounds 4 ounces. It was examined in the Pathological Department at London Hospital and the following is the report:

Fibrous hypertrophy of pulp with trabecular hemorrhages in the spleen. Banti's disease. March 21, 1914.

There has been no further hemorrhage and his doctor writes as follows: " He has been living the life of a gentleman farmer and is in excellent health. Lately he has had to take an active part in hard manual work, owing to the shortage of labor, and he has been able to do it in a wonderful way."

Case II.—The second was a male, aged twenty-eight, whom I was asked to see as a case of chronic gastric ulcer, with a view to operation.

Five years previously he had had pain after food for a few weeks. In September, 1915, he had a profuse and painless hæmatemesis followed by melæna. He was in bed for five weeks and remained well until February 27, 1916, when he again had hæmatemesis which continued for over a week. When I saw him he had been ten weeks in bed and was recovering.

On examination there was an obvious splenic enlargement. His blood examination, April 1st, showed: Red cells, 3,270,000; hæmoglobin, 55; color index, 0.8; leucocytes, 2200; poly. neutrophiles, 54.5; poly. eosinophiles, .5; small lymphocytes, 23; large lymphocytes, 15; large hyaline, 6; coarse basophile, 1. Wassermann negative.

I diagnosed splenic anæmia and on May 9, 1916, performed splenectomy. Stomach, duodenum and gall-bladder normal, liver firm but not cirrhotic. Spleen weighed one pound.

Pathological Report.—Fibrosis of pulp of spleen.

He made an excellent recovery and on May 22nd the blood examination showed: Red cells, 6,387,000; hæmoglobin, 90; color index 0.7; leucocytes, 7,800; poly. neutrophiles, 72; poly. eosinophiles, 0; small lymphocytes, 16; large lymphocytes, 7.5; large hyaline, 4.

He has had no further symptoms and remains in perfect health.

CASE III.—The third case of this nature was a girl of twenty-one who had been known to have an enlarged spleen for fourteen years. Two years previously she had had severe epistaxis and in October, 1915, sudden profuse hæmatemesis. Six weeks before admission to hospital she had another attack, followed by a further one a few days later. She was admitted to the London Hospital May 27, 1916, six days after the most profuse bleeding she had had. On examination the spleen and liver were both enlarged; ascites was present.

The blood examination was as follows: Erythrocytes, 1,990,000; hæmoglobin, 20 per cent.; color index, 0.5; leucocytes, 2000; poly. neutrophiles, 53 per cent.; poly. eosinophiles, 0; small lymphocytes, 32; large lymphocytes, 12; large hyaline cells, 3. One normoblast seen. Wassermann negative.

Seventeen pints of fluid were withdrawn by tapping.

I saw her, with a view to splenectomy. This I did on June 13, 1916. The stomach, duodenum and gall-bladder were normal, but the liver was large and cirrhotic. The spleen weighed 1 lb. 9 ozs.

Pathological Report.—General sclerosis of spleen with periarterial hemorrhages.

She made an excellent recovery and on July 29th the blood examination was as follows: Erythrocytes, 4,687,000; hæmoglobin, 55 per cent.; color index, 0.6; leucocytes, 3200. Rouleaux formation very poor. Poly. neutrophiles, 42.5; poly. eosinophiles, 4; small lymphocytes, 31; large lymphocytes, 16.5; large hyaline cells, 5; coarsely gran. basophiles, 1; poikilocytosis.

On June 11, 1917, I saw her apparently in perfect health. She expressed herself as never having been so well in her remembrance. Seven weeks later she died of sudden profuse hæmatemesis. Unfortunately there was no post-mortem examination.

These three cases taken together are instructive. They are in order of severity. The first two undoubtedly splenic anæmia, the last the terminal stage of Banti's disease.

In the first patient the blood changes are almost confined to the leucopænia, in the second leucopænia is more marked, and there is an increase in the lymphocytes with diminution in red cells and hæmoglobin. In the third all these changes are prominent.

The result of splenectomy was to restore the condition of blood to nearly normal in fourteen days in No. 2, but in the last patient, although her red cells showed marked improvement, leucopænia and lymphocytosis remained. Unfortunately, no blood examination was made later than six weeks after her operation.

In the other cases in whom no hemorrhage had occurred the blood changes before and after operation were equally striking. All remain in perfect health and have had no hemorrhage. The following is an example:

CASE IV.—A. B., aged twelve, was admitted to the London Hospital, June, 1914, with spongy gums and a tendency to bruising. His spleen was then noted to be enlarged. Four months later he was readmitted with ascites and I was asked to see him with a view to splenectomy.

The abdomen was full of fluid, the spleen reached to the umbilicus. Wassermann was negative. *Blood examination,* November 16, 1914: Erythrocytes, 4,300,000 per cmm.; hæmoglobin, 75 per cent.; color index, 0.8; leucocytes, 2300 per cmm. *Stained blood:* Polynuclear neutrophiles, 54 per cent.; polynuclear eosinophiles, 2 per cent.; small lymphocytes, 20 per cent.; large lymphocytes, 20 per cent.; large hyaline cells, 4 per cent.

I operated November 30, 1914. Large amount of ascitic fluid with a large cirrhotic liver. Spleen weight 19 ounces.

Pathological Report.—Fibrosis of reticulum of pulp of spleen. Hemorrhage and slight deposit of iron pigment in and around adventitia of vessels close to malpighian bodies.

There was some re-accumulation of fluid during convalescence, but, during his last week in hospital, which he left December 23rd, the circumference of his abdomen diminished two inches. On December 12th his blood was practically normal. *Blood examination,* December 12, 1914: Erythrocytes, 4,800,000 per cmm.; hæmoglobin, 80 per cent.; color index, 0.8 per cent.; leucocytes, 5000 per cmm. *Stained blood:* Polynuclear neutrophiles, 75 per cent.; polynuclear eosinophiles, 2.5 per cent.; small lymphocytes, 5 per cent.; large lymphocytes, 8.5 per cent.; large hyaline cells, 8.5 per cent.; transitional neutrophiles, 0.5 per cent.

He has been in perfect health since and now (nearly four years after operation) is an engineering apprentice.

Giffin [1] reports that of 24 survivors out of 27 operated on at the Mayo Clinic 2 died of hemorrhage a year and five and a half years after operation, and that in 3 others hemorrhage at different periods after operation occurred. I know of two similar cases that have occurred in the practice of other surgeons.

All cases of splenic anæmia should be operated on early. When cirrhosis of liver has supervened, although the patient may be restored to apparent health, fatal hæmatemesis may suddenly occur.

[1] ANNALS OF SURGERY, 1915, lxii, 165–170.

SURGICAL ASPECTS OF RIGHT SUBPHRENIC ABSCESS*

By Joseph Burke, M.D.
of Buffalo, N. Y.
Attending Surgeon to the Sisters' Hospital; Consulting Surgeon to the Emergency Hospital

For the purpose of this paper subphrenic abscess is understood to be a circumscribed collection of pus beneath the diaphragm and in contact with some portion of it, usually between the diaphragm and the upper surface of the liver.

I have purposely confined my remarks to a consideration of subphrenic abscess situate to the right of the falciform ligament of the liver, for my experience with left-sided abscess has been too limited, confined to two cases only; while on the contrary I have observed eighteen cases of right-sided abscess. The consideration of this experience of eighteen cases will form the basis of my paper, a clinical analysis from a personal standpoint.

The falciform ligament plays a very decided part in subphrenic abscess, for it is the dividing line of the subphrenic space, cutting it into right and left areas; the right being bounded above by the diaphragm, below by the liver, and on the left by the suspensory ligament; the transverse colon and its mesentery form the lower border; the colon and adjacent omentum adherent to the parietal peritoneum being firm seldom permits the abscess to perforate into the general peritoneal cavity. Clinically the causes of abscess on the right of the ligament can be traced to infectious processes in the liver, gall-bladder and ducts, duodenum and appendix.

It is frequently stated that the majority of subphrenic abscesses contain gas; the term pyopneumothorax subphrenicus was introduced by Von Leyden to describe this form of abscess. In passing I will state that in our whole series of eighteen cases there was not one of them that contained gas, and this is the rule in right-sided subphrenic abscess, though the late Alex. Johnson and others asserted the contrary.

In our eighteen cases there were seven subsequent upon acute perforation of the appendix, two cases were due to perforation of duodenal ulcer; one due to perforation of gastric ulcer; four cases of gall-bladder infection; one to cancer of the stomach and one to trauma. In the remaining cases unknown. Subphrenic abscess following appendicitis may occur in four ways: (1) As a result of general peritonitis; (2) direct extension up the lumbar peritoneal fossæ from the pelvis; (3) through the medium of the portal vein, pyelophlebitis; (4) lymphatic extension either up through the retroperitoneal tissue or up the lymphatics around the deep epigastric artery to the falciform ligament.

Symptomatology and Diagnosis.—Generally speaking, subphrenic abscess

*Read before Steuben County Medical Society, Corning, N. Y., May 28, 1918.

was a clinical rarity up to 1845, when Barlow drew attention to it. Volkman, in 1879, was the first to operate for it, and Von Leyden in 1880 made the first diagnosis of subphrenic gas abscess; his memorable monograph in which he described the differential diagnosis of pyopneumothorax subphrenicus is a milestone in the history of medicine and surgery. In all the modern text-books of diagnosis Von Leyden's work is quoted and nothing new has been added to our knowledge of the diagnosis of subphrenic gas abscess since that time, though very recently from the clinic of Franz Herzog in Pozony there came a brand new observation, namely: When the patient sat up there was dulness in the epigastrium while in the horizontal position the note was tympanitic. In pyopneumothorax above the diaphragm, the change in percussion notes is confined to the thorax alone and does not reach the abdomen as in subphrenic gas abscess.

In nearly every article that I have read concerning subphrenic abscess there is a woeful lack of details in the description of the physical signs that existed in the personally reported cases; in fact it would lead one to infer that the diagnoses were made from suspicion only, not from definite characteristic signs. Apropos of this, in the 1918 year book of surgery, the editor laments the lack of team work between the internist and the surgeon, stating that if there were greater coöperation between these two, the early diagnosis and treatment of subphrenic abscess would be the rule and the mortality less. There is no domain in surgery where it is all important that the surgeon be the master of the principles of physical diagnosis, as in a case of subphrenic abscess. In many cases diagnosis is not difficult, in others most obscure. There is no other affection that requires so complete a history and thorough and orderly an examination as subphrenic abscess. I have analyzed every case that has come under my notice of subphrenic abscess and there stand out two striking points that I have almost invariably observed and upon these points—everything else considered—I have made my diagnosis.

(1) An irregular line of the upper border of the liver dulness, the highest point of this dulness being in the midaxillary or anterior axillary line—in other words, the dulness is not the uniform parabolic dulness found in pleurisy or empyema, but irregular and triangular with the apex of the triangle upward in the midaxillary or anterior axillary line.

(2) The respiratory mobility of the diaphragm in all of my cases, with one exception, was preserved; in that case there was a complicating serous effusion in the pleura. In all of our cases which were due to appendicitis there was a uniformly typical picture; that which first elicited our attention that something was wrong in the convalescence was the fact that there was a slight elevation of the evening temperature, varying from 101½° to 99° in the morning, with the pulse rate correspondingly increased, and, strange as it may seem, respirations were not in every case increased. Instead of the patient showing progress in well-being after an operation for appendicitis, there would be an absence of appetite, coated tongue and, as the case

progressed, increasing anæmia—in other words, a slowly developing picture of suppuration in some part of the body. It has been said that the complete absence of cough and expectoration characterizes subphrenic abscess; in my observations there has been a slight, short, painful irritating cough in a great many of our cases. Von Leyden lays particular stress upon the absence of cough and expectoration in the differential diagnosis of gas abscess from pneumothorax. As the case goes on the appendicitis operation wound is looked at and found healthy; physical examination of the patient shows a slight rise of the diaphragm on the right side; these signs attract our attention to the subphrenic space; repeated examinations show increasing physical signs, and, when the abscess is frank enough, I have found in my cases the following signs: There is a slight increase in the right lower chest dimensions; the left side of the chest moves more than the right side; there can be mapped out a triangular dulness which merges with the liver dulness in the midaxillary line, the apex of this triangle or sharply convex area of dulness is in the midaxillary or anterior axillary line; there is usually a striking differentiation from the pulmonary resonance. If gas be present in the abscess, there is pulmonary resonance, next tympany, and then liver dulness. The respiratory mobility of the upper line of dulness in the cases that I have seen has been preserved; though somewhat arrested it was never entirely absent.

Right here is the place where we can discuss the diaphragm phenomenon, that is, whether the excursions of the diaphragm are interfered with when subphrenic abscess is present. In the normal individual the diaphragm phenomenon can in many cases be determined by inspection, moving downward with every inspiration and upward with expiration—the so-called Litten's sign. In the cases of subphrenic abscess that I have observed, Litten's sign was present in one case only. Again, in the normal individual the mobility of the diaphragm can be always demonstrated by percussion.

The *respiratory mobility* of the upper line of dulness in subphrenic abscess, that is, the respiratory mobility of the line where the pulmonary resonance ends and the dulness of the upper limit of abscess begins, in all of my cases with but one exception was preserved. Whether this can be designated as the mobility of the diaphragm, I cannot say. It is possible that this lowering of the line of dulness in deep inspiration is caused by the filling in of the costopleural sinus by the lung itself and gives us the percussion phenomenon of mobility of the line of dulness and cannot be interpreted as a measure of active phrenic movement. Hoover made a correct observation of a case of subphrenic abscess in which he says that his sign was the determining factor in the differential diagnosis between empyema in the chest and subphrenic abscess in a case in which he diagnosed subphrenic abscess and found it to be correct upon operation. He found "that the costal border of the affected side had a greater lateral excursion than the sound side, due to the loss of the normal antagonism of the diaphragm to

the action of the scaleni and intercostals of the affected side. This sign indicated to him an upward displacement of the diaphragm."

In the cases of pleurisy with effusion or empyema the line of dulness does not vary with inspiration or expiration, due to the filling up of the pleural sinus with fluid, to the presence of adhesions in some cases, to the temporary compensatory enlargement of the opposite lung and to the usual pain in pleurisy. In subphrenic abscess, however, there is a different hypothesis; the lung of the affected side although pushed up by the diaphragm is compressed but very little (except in gas abscess where it may be pushed up as high as the second rib and in such a case there is usually a complete paralysis of the diaphragm on the affected side) and hence in deep inspiration the pleural sinus is filled and the upper line of dulness in subphrenic abscess moves downward with inspiration. To determine whether the diaphragm moves downward with inspiration in subphrenic abscess or in pleurisy with effusion or empyema, besides percussion we need only to palpate the lower border of the liver to see whether it moves with respiration. If the liver moves downward with inspiration we are certain that the diaphragm moves downward with inspiration. This may be due to the filling of the costopleural angle by expansion of the lung in deep inspiration. Whether the diaphragm moves downward of itself with inspiration in subphrenic abscess, I cannot prove, because it has been demonstrated that in acute infections of the abdomen, particularly in cases of appendicitis, the diaphragm movement of itself becomes somewhat arrested, in some cases fixed, and its movement is a passive movement if it exists at all. I interpret, therefore, the mobility of the upper line of dulness in subphrenic abscess by inspiration as not an active diaphragm phenomenon, but as due to a filling of the costopleural sinus by expansion of the lung in deep inspiration.

Recently Major Sayle, M.R.C., suggested the limitation of diaphragm movement in acute appendicitis; this is worth investigating, particularly from an X-ray standpoint. In many cases the liver becomes adherent to the chest wall and in these cases the liver is not pushed downward, nor does it move with respiration. In massive effusion into the right pleura the liver is found pushed downward and the heart pushed to the left. In subphrenic abscess I have seen the heart's area encroached upon twice, and I have seen the liver pushed downward in right subphrenic abscess so much that in one case the diagnosis was made, by another physician, of acute cholecystitis or pericholecystitis. It was very recently demonstrated in some of my cases by the X-ray that after recovery from subphrenic abscess the diaphragm moved upward and downward with respiration, though it seemed to the radiologist that the excursions were limited.

In some cases there is heard early in the disease perihepatic friction sounds, but I have observed no appreciable difference in the fremitus nor any difference in the normal auscultatory phenomena, though compression of the right base is often found. In two cases I have found the heart displaced,

in some of our cases the liver has been pushed downward, and pressure upward directed against the lower border of the liver caused pain.

In about one-half the cases of subphrenic abscess in general, the onset is sudden, in the other half insidious. In cases of sudden onset the cause is usually a perforation of a hollow viscus, *e. g.*, the duodenum or stomach.

Pain is the rule in the acute occurring abscess, and this is referred generally to the point of pus formation.

In the insidious cases, pain is not the rule. When pain occurs in acute perforation it is usually the severe, stabbing pain of peritonitis.

Vomiting occurs very frequently as a symptom, perhaps in about one-third the cases, and when it is present it is usually severe, uncontrollable and due to the localized peritonitis consequent upon an acute perforation of the stomach or duodenum. In our cases vomiting occurred in two and was due to duodenal perforation and peritonitis. The vomiting was the most prominent and persistent symptom in these two cases.

Hiccough is sometimes observed. In our cases it occurred once, only.

Localized swelling in the abdomen is sometimes observed, but this occurs somewhat late in the course of the disease. Swelling just below liver margin occurred in one of our cases. Over this area of swelling, pain was present upon pressure. Given a picture of such a febrile illness, as above described, following some *abdominal* disease, whether in the upper or lower abdomen, we must always think of subphrenic abscess as the cause of the trouble; added to this polynuclear leucocytosis and certain physical signs, we can say for almost a certainty that subphrenic abscess is present. We are then justified in using the diagnostic needle to ascertain the presence of pus. There are in 33 per cent. of the cases of subphrenic abscess, infections of the pleura, coincidently with the abscess or following transpleural operations for the subphrenic abscess. There may be pleural effusion of either pure serum or pus.

The site usually chosen for puncture corresponds to the convex dull area. When the needle enters the diaphragm, the movements of respiration are communicated to it. This will tell whether the pus is above or below the diaphragm, but will not tell if it is a subphrenic abscess or an abscess of the liver. If, when making the puncture, serous fluid enter the needle, we must not assume that a serous effusion in the pleura is the cause of the illness; we must push the needle in farther and, if pus is shown in the needle, the diagnosis of pleurisy with effusion as well as subphrenic abscess is made clear.

A word of caution about the needle will not be amiss. I use a needle three inches long with good large caliber so that deep collections can be reached. It is obvious that to perforate the diaphragm an ordinary hypodermic needle will not do. If the caliber is not large enough flakes of fibrin will plug the needle and give us a negative result though pus may be present. The needle should be well tempered; cases have been reported in which needles have been broken and lost in the body. Be sure that the needle

be true, try it out with sterile water before using. When the needle is true and nothing apparently appears in the syringe after plunging and withdrawal, the piston should return immediately after release on account of vacuum, but, if it does not spring back, then gas from a gas abscess may be in the cylinder.

Treatment.—Subphrenic abscess is a distinctly surgical affection, though a limited number will recover without surgical intervention.

This may be accomplished in three ways:

First, the pus may become encapsulated between the liver and the diaphragm, rendering the pus sterile and finally causing absorption. I have encountered two instances of walled-off serous exudate, in the right subphrenic space, in cases whose histories would lead one to think of a previous subphrenic abscess. I remember a case of gall-bladder disease in which when the abdomen was opened, in the upper right rectus line, there was found a pure serum, totally encapsulated, reaching and occupying the right subphrenic space. At the time of operation I speculated as to the probability of subphrenic abscess whose solid elements had been absorbed not unlike we find in cases of hydrosalpinx.

Second, the pus may rupture into a bronchus and spontaneous cure result. I have seen an undoubted case of this nature in a young man who gave a history of an acute attack of appendicitis with continued febrile illness lasting three months. At the end of the sixth week there occurred the sudden coughing up of a foul smelling pus, this expectoration being copious and extending over a period of six weeks with final apparent recovery. I saw the patient after a second attack of appendicitis and, on account of the rigidity and pain in the right hypochondrium, I made a high right rectus incision so that I could investigate the gall-bladder. Upon opening the peritoneum there escaped about a pint of a clear serous fluid, which had been encapsulated and extended up between the liver and chest wall to the subphrenic space. There was a complexity of adhesions in this case, particularly of the ascending colon, and these findings led me to believe that the man had had a subphrenic abscess complicating his first attack of appendicitis.

The appendix at operation was retrocæcal.

Third, the pus may evacuate itself spontaneously through the alimentary tract.

Fourth, a case has been reported in which the abscess found its way to the umbilicus where it discharged.

The mortality in subphrenic abscess is variously placed at between 35 per cent. and 55 per cent., whether operated or not.

I have carefully reviewed the mortality statistics of operated cases of subphrenic abscess and the percentage coincides with my own personally observed cases. It is a most discouraging fact that about 50 per cent. die after operation. In my judgment the reason for this discouraging mortality is twofold:

First, the lack of proper and early diagnosis, and,

Second, the inappropriate method of surgical attack in the individual case. It is not every case that responds to transpleural operation, nor abdominal operation, nor a combination of both. I earnestly believe that every case of subphrenic abscess should be a law unto itself, the etiological factor and the anatomic situation being the determining factors.

In the cases of death in my own series, I have always wished—post mortem—that I had made a different attack in every case; in all of them I operated transpleurally. Had I analyzed every individual case as to the causal factor and operated accordingly, I am sure that my mortality would have been less. It is not alone necessary to say that pus is present in a given case, but we must localize it if possible, according to our knowledge of the divisions of the subphrenic space and the etiological incidence.

Therefore, in my opinion, based upon the mortality statistics gleaned from a none too copious literature and from my own series of operated cases, it is necessary to make every case an individual one; we must apply no fixed rule for operative attack, but, judging from the etiology and the anatomic situation of the abscess, as well as its extent, we must determine whether the operation should be done transpleurally, abdominally or by a combination of both methods. I will analyze some of my own personal fatal cases first, that is, those cases that died after operation. My first post-mortem regret was after subphrenic abscess following a case of gangrenous appendicitis in a child of eight years. I operated transpleurally for the subphrenic abscess with the prompt formation of an infected pyopneumothorax with subsequent death. Had I attacked through the original appendix wound and found the abscess from below, I would probably have saved my patient. In contradistinction to this, I had a case of a boy of thirteen years on whom, some fifteen days previously, I operated for perforated appendix and general peritonitis in whom sudden symptoms of complete obstruction of the bowels asserted themselves, due to a large accumulation of pus which found its way up along the ascending colon to the subphrenic space. I attacked this abscess through the original appendix incision and immediately tapped a large abscess whose upper limit was the diaphragm; this was abundantly proved by the fact that I inserted a large drainage tube which reached his diaphragm, causing uncontrollable *singultus* until the tube was partly withdrawn.

This case recovered; the bowel obstruction disappeared simultaneously with the evacuation of the abscess.

I will relate somewhat in detail the histories of a few more cases that have been highly instructive to me and I hope will be of value to others. The first case is a subphrenic abscess following acute gangrenous appendicitis. The patient made a splendid appendix operative recovery; the day after his operation he felt apparently well, temperature was normal but the pulse did not return to its normal plane; there was a drain in this wound which was dressed daily. The patient complained

of no pain but a slight short, sharp irritating cough at night. The temperature in the evening would be up slightly, sometimes 99½° (highest 101°); the patient's tongue remained coated, appetite was absolutely *nil,* food had to be forced upon him; he remained in the hospital three weeks, always having a little temperature and cough, and I suspected that he had an infection beneath his diaphragm. I told the house surgeon to make a leucocyte count and he reported to me the blood count was normal, and the signs I had found indicating subphrenic abscess were so slight and the reported blood picture normal and the patient up and around, the appendicitis wound healed, I did not feel justified in putting the needle in. About three weeks later I was called to see this patient, who told me he was not getting along as well as he expected; I examined him and found every evidence of right subphrenic abscess; the needle proved the presence of pus, and at operation, which I did the same day, transpleurally, I emptied about a quart of pus from beneath his diaphragm.

There was one case in which there was displacement of the apex beat, marked cyanosis and dyspnœa particularly noted upon change of position of patient following early operation for perforation of duodenal ulcer. In this case the displacement of the apex beat, the dyspnœa and cyanosis were undoubtedly due to the large accumulation of pus which encroached upon the cardiopulmonary areas, due to the fact that the abscess had existed seventeen days without recognition.

M. T., aged twenty-two years. Entered hospital with perforation of duodenal ulcer. Immediate operation; after operation there was elevation of temperature and on the seventh day the patient began to cough and expectorate. On the tenth day the cough became frequent and expectoration copious. On the seventeenth day after the operation, he complained of pain in the right side. On the nineteenth day, the temperature was 104°, and patient coughed very frequently when changing position.

Physical examination: Patient prostrated, lips cyanosed; there is frequent cough with copious expectoration; labored breathing; the lower right chest bulging; the intercostal spaces obliterated; measurement of each thorax half shows a difference of one inch of the right larger than the left; apex beat cannot be seen and seems diffuse upon palpation in the left mammary line.

Percussion: The upper border of liver dulness begins in the parasternal line at the upper border of the sixth rib. In the mammary line of upper border sixth rib; axillary line of upper border sixth rib; respiratory mobility present. Above the line of liver dulness there is harsh inspirium, somewhat prolonged expirium; fine râles at the end of inspirium; liver extends laterally to the left mammary line and extends about two finger breadths below the costal border; needle introduced into the axillary line showed pus. Diagnosis: Subphrenic abscess.

I will report another case of a young man (J. B.), nineteen years of age, who was sent into the hospital on account of an acute illness that began three and one-half weeks previously, in which displacement

of the apex beat was present. The patient complained of slight pain to the right of the epigastrium which radiated to the right side beneath the ribs; pain also went to right shoulder. The pain at first was mild, but soon became so bad that the patient was unable to get out of bed. He coughed about a week before he was taken with this pain, but has not coughed during the present illness; feels weak, short of breath, has no appetite.

Temperature upon entrance to the hospital, 100°; pulse, 100; respiration, 20.

Physical examination showed the patient emaciated, lips cyanosed. This is the second case of subphrenic abscess in which cyanosis was observed. Tongue red, dry, slightly coated. Apex beat diffuse. Point of maximum intensity in fifth interspace in mammary line, showing displacement of nearly one inch to the left. Lungs are normal except in the right lower portion, where compression breathing is noted above the line of liver dulness. There is marked bulging noted in lower chest. Percussion revealed following: (1) At parasternal line liver dulness begins at upper border of fifth rib. (2) Mammary line, upper border of fifth rib. (3) Anterior axillary line, upper border of sixth rib. (4) Midaxillary, seventh rib. (5) Post-axillary line, at eighth rib. Litten's phenomenon noted on both sides of chest. Liver dulness extends about three finger-breadths below margin of ribs. Liver pushed toward left and involving Traube's space.

Respiratory mobility all along line of liver dulness. Needle inserted in eighth intercostal space in midaxillary line and pus demonstrated.

The history of another case ought to be related for the reason that four consecutive false diagnoses were made by four different physicians who saw the patient at various intervals during his illness; it will show how the signs and symptoms of some cases of subphrenic abscess are variously interpreted. A male Italian thirty-five years of age, whom I first saw on the forty-second day of his illness; the first consultant who examined the patient with the family doctor made a diagnosis of duodenal ulcer, which in my mind was absolutely correct at the time of his examination, and his diagnosis was the foundation of our diagnosis made on the forty-second day of his illness. The diagnosis of right-sided pneumonia, pleurisy with effusion, unresolved pneumonia and tubercular infiltration of the lung were by various consultants subsequently diagnosed. I examined the patient on the forty-second day of his illness and was able to demonstrate to his family physician this triangular cupping of the upper line of dulness with the apex in the midaxillary line and the respiratory mobility of the diaphragm markedly preserved, showing conclusively that there existed a subphrenic abscess. The diagnostic needle and the operation proved the correctness of the diagnosis. It is strange that these patients, as in this case, can in the beginning be so desperately ill and after a time seemingly improve, get around upon their feet with very little evidence of the gravity of the nature of the illness. It was thought that this patient was improving because he was able to be up out of bed. His tongue when I saw him was dry brown, pulse 96, temperature

99° and blood count 19,000. An earlier diagnosis in this case would undoubtedly have saved the patient's life. I operated transpleurally, found the abscess, introduced suitable drain, but the patient succumbed on the fifth day. I believe in this case that had I used a combination transpleural-abdominal attack, the chances for recovery would have been enhanced.

I will report another case which will illustrate that a patient may have a subphrenic abscess and at the same time pleurisy with effusion. A city fireman, thirty-five years of age, consulted me in March, 1913; he gave a history of typical periodic gall-bladder attacks. Three months later I saw him in consultation. The patient was taken suddenly with great pain in the right hypochondrium, and thereafter developed a febrile illness with cough. On the twenty-first day a needle was inserted between the third and fourth ribs in the right midaxillary line; a pure serum was obtained. The pleura was aspirated and about a pint of serum was removed; there was no change in the patient's condition, however, and the day following the aspiration of the pleura I saw the patient in consultation. On account of the history of gall-bladder disturbances previous to the last illness, the abdominal origin of the present illness, the convex area of liver dulness with its apex in the midaxillary line and a marked tenderness over the gall-bladder region made me suspicious of subphrenic abscess. The diagnostic needle and open operation demonstrated the existence of an abscess beneath the diaphragm. In this case transpleural operation was done by another surgeon, the abscess demonstrated. I believe that had the combination method—that is, transpleural-abdominal method—been used, his chances would have been better.

Another case that I wish to dwell upon is that of a young man, twenty-five years of age, who spent ninety days in the hospital after an operation for diffuse peritonitis following appendicitis. After the appendix operation with drainage the patient made an apparent recovery until the eleventh day. His pulse was down, temperature normal morning and evening, but his appetite did not return; his tongue remained coated and he became anæmic in spite of the fact that according to the chart he was improving. On the eleventh day he complained of a dry, irritating, painful, unproductive cough, his temperature began to go up, pulse increased and he progressively grew worse. The appendix wound healed, there was nothing in the abdomen that could be demonstrated to account for his temperature. Repeated daily examination made me suspicious of subphrenic abscess. The physical signs were so indefinite in the beginning that I did not feel justified in using the needle. The following morning the lower border of the liver was tender to pressure, moved with respiration, but in the right midaxillary line there was an elevation of the liver dulness. I inserted a needle and pus was found present, I did a transpleural operation and from this the young man seemed to be making a good recovery until about the twelfth day, after when the temperature again began to become elevated. The young man began to show evidence of more infection, the tube in

the subphrenic abscess cavity was free and draining and examinations showed evidence of pleural involvement; the needle brought pus; resected another rib and emptied the pleura. The patient began to improve for several days and then the temperature began another ascent and the patient developed lung abscess, which I opened through the incision already made in the pleura; he was in desperate condition and at one time on the operating table we all thought he was dead. He recovered from the operation and the day following he developed an acute lobar pneumonia, which lasted seven days and ended in a definite crisis, and from that day the patient made an uninterrupted recovery. He was ninety days in the hospital from the day of the operation until the day he left. During that time he had an operation for perforated appendicitis with general peritonitis, subphrenic abscess, empyema and pulmonary abscess and then went through a typical lobar pneumonia.

The last case I saw recently in consultation with Doctor Stumpf.

Mrs. C. M. was first taken sick suddenly with rather severe vomiting; followed next day by a watery brownish diarrhœa. About one-half dozen movements a day; cleared up under treatment; constipation followed. Temperature ran from 101° to 102° (continuous fever). This lasted about three days. I saw her on the sixth day of her illness; she complained of such severe pain in epigastrium and was hardly able to breathe. Following this attack, temperature down to normal, running from 97° to 100°; pulse about 80. Patient still complained of steady pain along border of ribs, right side. Blood count showed 25,000 whites; differential, 80 per cent. polymorphonuclears; hæmoglobin, 65 per cent.

Physical Signs.—Patient pale; dyspnœa; flushed. Alæ nasi visibly active on inspiration and expiration. Apex beat, normal. Abdomen, uniformly distended; painful swelling in right hypochondrium in anterior axillary line. Percussion, left side of chest normal; heart area normal. Right side—Liver dulness begins in parasternal line upper border fifth rib; mammary line upper border of sixth rib; midaxillary line upper border of sixth rib; normal dulness beyond midaxillary line posteriorly. Above line of dulness some indistinct râles at end of inspirium; also heard during expirium; over the area of dulness, no breathing sounds audible. Liver—Lower border extremely tender on palpation; pressure caused excrutiating pain, marked when tried to outline costal border. Respiratory mobility present, though somewhat impaired. Needle inserted in midaxillary line between seventh and eighth ribs, also ninth ribs; each time brought a thin, watery, sanguinous fluid (under pressure). Temperature, 101°; pulse, 84; respiration, 20, when patient entered hospital. Just before operation, temperature 100°; pulse 92; respiration 28; patient given ⅙ grain morphine at 12 P.M., previous to operation, and patient rested comfortably. Tongue clean, moist, no coating.

Operation.—June 2nd, 10 A.M. Dr. Jos. Burke; assistant, Doctor Stumpf. Dr. O. Rebescher, anæsthetist. Upper right rectus incision about ½ inch from its right border. As soon as peritoneum was opened, a yellowish, greenish pus freely exuded. Enlarging the incision

upward, the falciform ligament could be beautifully seen forming the left boundary of the abscess cavity. Careful sponging brought out pus and as adhesions were gently separated up over the liver and right abdomen, about a pint of thin, watery, sanguineous fluid exuded. Sponge inserted under liver toward foramen of Winslow also brought yellowish, green pus in abundance. A sponge was also introduced between the liver and chest wall to mop out that cavity. About 9 inches of sponge holder inserted until it came in contact with the diaphragm. After dry mopping a Mikulicz drain introduced down to foramen of Winslow and another inserted between liver and chest wall to diaphragm. Incisions closed above and below drains. Recovery.

In concluding this paper I would like to state that the very earliest diagnosis of subphrenic abscess is all important to the success of operation. The longer the case remains unidentified the poorer are the chances for recovery. In cases that are frank, that is, where the accumulation of pus is large, the prognosis is good. Where there is a case of suspected abscess beneath the diaphragm, I advocate unhesitatingly the free use of the diagnostic needle, one that is sufficiently long, with good caliber. If gas is present do not be disappointed if the needle shows no pus upon the first introduction, but plunge again, a rib space lower; perhaps persistency will reward the effort.

In regard to the choice of method of operation, personally I always attack by the abdominal route as in my last case, and if necessary, combine it with the transpleural route. In this last case, I noticed particularly how well the falciform ligament guarded the general peritoneal cavity from extension of the suppurating process. It is possible that many of the fatal results after transpleural operation were due to multilocular abscesses, one only of which was reached through rib resection, while in the abdominal method a second abscess would scarcely be overlooked.

HYPERNEPHROMA OF THE FALCIFORM LIGAMENT OF THE LIVER

By Anthony H. Harrigan, M.D.

of New York

Associate Visiting Surgeon, Fordham Hospital

Acting upon the advice of Cullen that surgeons should publish their unique cases, the following history is presented.

Female, aged thirty-five years, married, one child. The family history is negative. The personal history is of no interest, save that the patient has had a large parenchymatous goitre for several years.

Present Illness.—During the past two years, patient has suffered from severe abdominal pain in the right upper quadrant. This pain is intermittent in character and does not radiate. It is referred chiefly to the region of the gall-bladder. There have been no typical attacks of biliary colic. No jaundice. At times the attacks are combined with severe vomiting. The attacks may last several days. Menstrual history normal. Urine examination negative. Vaginal examination revealed an anteflexed uterus. No adnexal disease. Diagnosis: Chronic appendicitis and possibly cholecystitis.

Operation (Misericordia Hospital, July 11, 1917).—Morphine-ether narcosis. A right rectus incision. The appendix was long and thickened. Appendectomy by the ligation method. The gall-bladder and the biliary ducts were negative for stone. A small mass, about the size of a walnut, was felt in the falciform ligament, close to the free border of the liver. It was readily removed by enucleation. Rather active hemorrhage took place following its removal, which was readily controlled by suturing the round ligament to the surface of the liver. The stomach and duodenum were negative for ulcer. Abdomen closed in layers. Uneventful recovery, with primary union of the wound. The patient was discharged from the hospital July 24, 1917. Has been in excellent health since.

Pathological Report (by George Hohmann, M.D.).—The greater part of the specimen consists of a delicate reticulated stroma, embedded in which are numerous variously sized, mostly large, somewhat spheroidal and oval cells containing a large nucleus, surrounded by granular cytoplasm. Here and there are collections of lymphoid tissue. The blood-vessels are few, their walls thickened, with one or two containing a hyaline plug. Diagnosis: Hypernephroma. The specimen was also examined by George Rohdenburg, M.D., who concurred in the diagnosis.

An analogous case, bearing the same title, was reported by Starr in Annals of Surgery, September, 1917. The tumor, in that instance, measured 20 cm. in diameter and weighed eight and one-half pounds. It lay between the folds of the falciform ligament. The case report, though

purely casuistic, calls attention to the rarity of the condition and refers briefly to the embryological origin of the tumor.

The subject of hypernephroma is of interest in this connection, from an ontogenetic viewpoint. From the study of embryology, it is known that the cells of an organ undergoing development may be snared or included by an adjacent tissue or organ. This phenomenon of misplacement, or abnormal situation, is called heterotopy. The kidney, the adrenal, the ovary and the testicle manifest this heterotopic tendency to a marked degree. It is assumed that the basis for this phenomenon lies in the close and common origin of these organs from the Wolffian body and ridge, proximity and contiguity favoring the accidental cell inclusion. It is probable that the primitive shoots of the embryonic blood-vessels transport the cells. The adrenal, of all organs, forms the most striking example. Adrenal rests are mainly found in the kidney and the liver. It is interesting to relate that this genetic aberration of the adrenal manifests itself, at times, in a bizarre manner, for adrenal rests have been found in the broad ligaments, in the pampiniform plexus, and in the semilunar ganglion. As is well known, the thyroid, the spleen, and the ovary have, at times, secondary glands, but even in these instances, the secondary glands are usually close to the parent organ. In passing, it may be stated that even accessory livers have been reported.

The subject of adrenal rests in the kidney is a debatable matter. Wilson holds, in marked contradistinction to Grawitz, that these so-called adrenal rests are really remains of the Wolffian body. The crucial point in the theory advanced by Wilson is that the tumors of the kidney described by Grawitz as hypernephroma have their origin in strands of nephrogenic tissue. These views are essentially theories. They are susceptible to argument. In sum, there are three interpretations of the hypernephroma of the kidney: The theory of Grawitz, that the tumor rises from an adrenal rest; the theory of Stoerck, that they are formed by proliferations of the secreting epithelium, and the theory maintained by Wilson, as above enunciated.

No doubt exists in regard to the occurrence of adrenal rests in the liver. They are by no means unusual and their presence is clearly explained on embryological grounds. It is a matter of histological demonstration that at one time during the development of the embryo, the adrenal cortex is in direct contact with that of the liver.

In conclusion, though the publication of this case report does not, in any manner, explain how adrenal rests reach, during embryological development, the falciform ligament of the liver, it serves, possibly, to call attention to an interesting pathological condition, important, incidentally, to the surgeon.

THE LOW LATERAL INCISION AND A METHOD OF NERVE BLOCK FOR APPENDECTOMY

By Leigh F. Watson, M.D.
of Chicago

Many operators believe that local anæsthesia in appendectomy is adapted only to interval cases in which adhesions have not formed. There are many cases in which the local method cannot be used; however, when it is possible, I believe that next to herniotomy, appendectomy is the most satisfactory of the major operations that are performed under local anæsthesia.

Success depends upon a proper incision and the ability to block the cerebrospinal nerves. When the incision is made directly over the base of the appendix, and the cerebrospinal nerves in the mesocolon are completely blocked before any manipulation is attempted, the operation is much easier than when it is done through a McBurney or the lateral rectus incisions of Battle, Kammerer, Jalaguier and Lennander. I have used this low lateral incision since 1910, in fifty patients who required removal of the appendix, either as an immediate or interval operation.

Anæsthesia for Incision.—Any local anæsthesia operation is successful only when it is painless, and too much emphasis cannot be placed upon the necessity of preventing the least pain in acute appendicitis. In this condition all pressure on the abdomen must be avoided. The initial infiltration of the skin should be preceded by ethyl chloride spray so that the prick of the needle is not felt. For additional injections and for the division of the different layers of the incision, the tissues should be held up with sharp-toothed anatomical forceps. It is usually advisable to inject the parietal peritoneum for a distance of one or two inches from the edges of the wound before the peritoneum is incised. Sharp scissors will be found preferable to a scalpel for cutting, because the tissues can be divided with the scissors without making pressure on the hypersensitive abdomen.

Incision.—The McBurney and lateral rectus incisions are too far removed from the base of the appendix for the local method. To expose the appendix properly through these incisions necessitates uncomfortable retraction on the external oblique and its aponeurosis. Many writers have noted that in the cadaver the base of the normal appendix is found at McBurney's point, while in the living subject it is below this point, usually on a level with the center of Poupart's ligament. A number of operators have called attention to the ease with which the appendix can be removed when operating for right inguinal hernia. If the incision is made directly over the base of the appendix, slight retraction on the edges of the wound will provide a good exposure, and it is less difficult to keep the small intestines out of the way than when the McBurney or lateral rectus incision is used. With

local anæsthesia, it is not practical to use sponges within the abdomen unless they are required by the presence of an abscess, tympanites, hemorrhage, etc.

A point one and one-half inches from the right anterior superior spine, on a level with a line connecting the two superior spines, is selected for the beginning of a vertical incision which extends directly downward for two to three inches, to a point just above and to the inner side of the internal abdominal ring. After incising the skin and subcutaneous tissues, the aponeurosis and external oblique are separated in the direction of their fibres by blunt dissection, which exposes the internal oblique. The inner flap is freed from the internal oblique until the linea semilunaris is reached, usually about one-half inch from the opening in the external oblique. At this point the internal oblique muscle and aponeurosis, and the transversalis muscle and aponeurosis, and peritoneum, are incised parallel to the incision in the external oblique muscle and aponeurosis.

Advantages of the Low Lateral Incision.—Traction to expose the appendix is avoided, because this incision, in the external oblique and its aponeurosis, the most resistant structures, is directly over the base of the appendix. It can easily be enlarged without weakening the abdominal wall. The iliohypogastric and ilioinguinal nerves are not injured because the incision lies between them. Opening the external and internal oblique muscles and their aponeuroses at different levels, preserves the gridiron arrangement of these structures and prevents post-operative hernia. When this incision is used there is also less opportunity for the small intestines to crowd into the wound, than when the higher incisions are employed.

Cerebrospinal Nerve-Block.—In simple appendicitis when the appendix appears in the wound after the peritoneum is incised, infiltration of the meso-appendix is often sufficient to permit a painless removal of the appendix, providing no traction is made at any time. In the majority of cases it is necessary to proceed as follows: The cæcum is grasped gently with moist pledgets of gauze and displaced to one side, usually inward, exposing the mesocolon, which carries the cerebrospinal nerves to the lower part of the ascending colon, cæcum and appendix. A small quantity of anæsthetic solution is injected through a very fine needle at short intervals along the mesocolon for a distance of three or four inches, for the purpose of blocking the cerebrospinal nerves, which are responsible for the sensation of pain that follows traction on the mesentery, and for the separation of adhesions. When the patient states that manipulation and traction are painless, and without the referred epigastric pain which is so characteristic of the usual local anæsthesia appendectomy when only the meso-appendix is blocked, the appendix is located and delivered into the wound. While anæsthesia continues complete, the adhesions are separated, the meso-appendix ligated and the appendix removed in the usual manner. The necessity for gentleness in handling the intestines is important, to avoid accidental traction on un-anæsthetized portions of the mesentery.

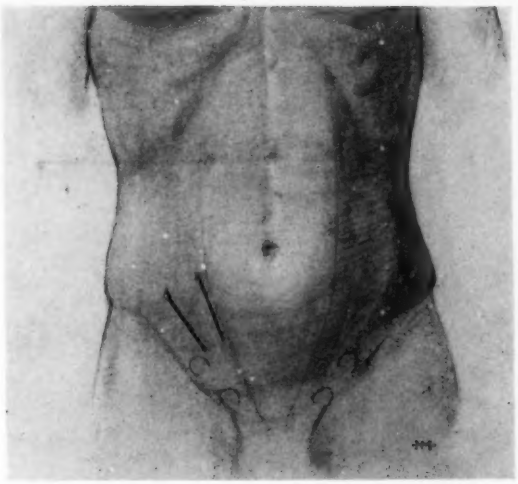

FIG. 1.—Low lateral incision for appendectomy. *A*, incision through skin, subcutaneous tissues, external oblique and its aponeurosis; *B*, incision of internal oblique and transversalis.

FIG. 2.—Mesocolon nerve block for appendectomy. Method of infiltrating the mesocolon to anæsthetize the cerebrospinal nerves supplying the appendix and its mesentery.

SURGICAL PATHOLOGY OF THE HUMAN PROSTATE GLAND

By Oswald S. Lowsley, M.D.
of New York

Before proceeding with a discussion of surgical pathological conditions of the prostate gland it seems appropriate to discuss briefly the embryology and anatomy of that organ.

The human prostate gland begins to develop at the third intra-uterine month from five different foci. These foci, as I have shown in a previous communication, originate as solid epithelial outgrowths from the posterior urethra and later from the five lobes of the prostate gland. The solid finger-formed buds later develop lumina which always remain small compared with those of the adult prostate until the great increase in size at puberty. At that time the epithelium, which has previously consisted of cuboidal cells two or three layers thick, becomes cylindrical in type and one layer in thickness, resting upon a felt-work membrane.

The five groups of tubules from which the gland originates become the five lobes of the prostate, namely: Anterior, posterior, right and left lateral, and middle lobes. The anterior lobe in early embryonic life is as prominent as other lobes of the prostate, but it usually atrophies about the time of birth. In some cases, as in that of a seventeen-year-old boy in my series, it remains as large and prominent as any of the other lobes, and there are several instances in which an hypertrophy of the anterior lobe tissue has occurred.

The posterior lobe is always present and is separated from the middle and lateral lobes by a rather firmly knit lamella of connective tissue in which the ejaculatory ducts are embedded.

The two lateral lobes and the middle lobe develop separately, as has been described, but they are not separated from one another by partitions of any sort and from the surgical standpoint their separate origin is of no consequence.

The subcervical group of tubules which I have described in detail elsewhere begins to develop at the fourth intra-uterine month and these become of considerable consequence, due to the fact that they grow back just under the mucosa of the urethra and within the sphincter, and, as my studies have shown, they become enlarged in almost 25 per cent. of men over thirty years of age. They form several types of tumors at the floor of the vesical orifice; the single tumors of varying sizes, the partially divided tumors and those divided into three portions. This condition occurs probably because of the continual pressure exerted by the action of the so-called Bell's muscles during each urinary act.

The anatomical arrangements of the different portions of the prostate are

of the utmost importance in the various surgical procedures in attacking pathological conditions of the prostate.

Wilson and McGrath (*Surg. Gyn. and Obstetrics,* December, 1911, pp. 647-681), in their splendid publication on the "Surgical Pathology of the Prostate," have pointed out many valuable facts. Seven of four hundred and sixty-eight cases were tuberculous, which disease these authors consider to be spread by the blood stream and to occur in the periphery of the lateral lobes. Secondary infections are occasionally present and Halle and Motz hold that surgical interference should not be attempted in cases with acute secondary infection. I agree with Albarran, who states that undoubted chronic inflammation exists in 100 per cent. of the cases of prostatic hypertrophy.

Harmon and Weigert believe that the prostate is practically always the seat of foci of infection in all cases of pyæmia and septicæmia.

ACUTE PROSTATITIS

Acute prostatitis is caused in the great majority of cases by the gonococcus. There is practically always some involvement of the prostate in every case of posterior urethritis. Careful observations by a number of writers on bacteriological studies of urethritis, show that in addition to the gonococcus there may be present Staphylococcus albus, Sereptococcus pyogenus, Colon bacillus, and a slender bacillus not identified. Mixed infections of the prostate are not rare.

Albarran and Cottet identified the colon bacillus, streptococcus, staphylococcus, and gonococcus in three cases of prostatic abscess.

Cohn found Staphylococcus albus present eleven times, Colon bacillus once, a diplococcus twice, and an unidentified bacillus once.

The prostate is undoubtedly one portal of entry for septicæmia, and when the gonococcus is the offending organism is practically always the original focus.

There are three types of acute prostatitis generally recognized, the most common being *acute catarrhal inflammation* which is always present in acute posterior urethritis, and nearly always caused by direct extension into the tubules by the gonococcus. The contiguous organs including the utriculus prostaticus, ejaculatory ducts, and seminal vesicles may be affected at the same time. Following the first type the second or *follicular prostatitis* develops. This condition is characterized by the formation of small abscesses, or dilatation of the prostatic tubules with pus which is not emptied from them, on account of some obstruction of the ducts, either due to temporary œdema or other causes.

An intensification of the secondary stage develops into the tertiary or *parenchymatous prostatitis,* in which the small collections of pus become larger, more of the stroma surrounding them becomes involved and finally the entire gland is increased in size, becomes hot, tender and tense, and is liable to disintegrate and form a large clinical abscess of the prostate.

The treatment of prostatic abscess naturally falls into two classes: viz., (a) Non-operative and (b) operative.

The *non-operative treatment* consists in relieving the retention of urine which frequently accompanies this condition by regular catheterizations with a soft rubber catheter if possible. Warm boric acid irrigations of the bladder are helpful, and upon withdrawing the instrument into the posterior urethra argyrol may be instilled. Very hot rectal douches may be given as often as every four hours, but are usually given twice daily. Some surgeons prefer to insert a so-called "cooling tube" into the rectum in such a manner that it rests upon the prostate. Cold water may then be run through it for one-half hour at a time. A very large percentage of the prostates affected subside without completely breaking down, and this fact is the strongest argument in favor of not operating upon every acute prostatitis. Such conditions should always be accompanied by gentle daily rectal examinations to determine the exact conditions present, as they may alter rapidly.

The indications for operative treatment of this condition are: (a) Fluctuation in any part of the gland as made out by gentle rectal touch. (b) Continued retention of urine. (c) Distressing pain. (d) Persistent elevation of temperature. In this connection it is worthy of note, that very frequently there is no elevation of temperature whatever, in certain cases which may involve most of the gland.

The operation of choice is the perineal section with intra-urethral rupture of the abscess, being careful to break down the honey-combed arrangement of tissues which usually is present. A tube is then introduced into the bladder which is left in place forty-eight to seventy-two hours, thus draining the urine from the bladder and allowing the pus to discharge around the tube, which is kept in place by one stitch taken in the skin closing the wound not too tightly and being tied around the tube to keep it in place.

The intra-urethral evacuation is much preferable to the method which has been recommended by certain surgeons, whereby the posterior surface of the gland is exposed and incised, for the following reasons: (1) Drainage is direct in the former and continues during the time the tube is in place and after it is removed; while by the latter method, the pressure of the rectum and levator ani muscle upon the sinus will prevent free drainage. (2) In the intra-urethral drainage the elasticity of the capsule of the prostate tends to aid in discharging the pus, while in extra-urethral incision the capsule will tend to close the incision as soon as the drainage tube is removed, and hence interfere with the complete evacuation of pus. (3) By the intra-urethral method with a drainage tube into the bladder complete emptying of that viscus is assured; while by the extra-urethral method that fact is not so absolutely assured.

Both of these methods of evacuating a prostatic abscess are preferable to a suprapubic operation with an intra-urethral evacuation of the pus into the bladder and suprapubic drainage of that organ.

OPERATIONS FOR SUPRAPUBIC DRAINAGE OF PROSTATIC ABSCESSES

Case	Age	Pre-operative diagnosis	Operative findings	Special treatment	Results	Days in hospital	Condition on discharge
1	20	Abscess of both lobes . . .	No pus	Suprapubic siphonage 5 days. Retention catheter 14 days	Wound healthy and dry on thirty-fifth day	40	Cured
2	23	Abscess of both lobes . . .	Abscess of both lobes at vesical junction. Much pus evacuated	Suprapubic siphonage 4 days. Retention catheter 30 days	Wound healed on thirty-third day	34	Cured
3	22	Abscess involves both lobes	No pus	Suprapubic tube out on fifth day. Retention catheter out on twenty-fourth day	Wound healed on twenty-fifth day	33	Cured
4	19	Abscess of both lobes. . .	Oz. ii of pus	Suprapubic tube out on second day. Retention catheter out on seventeenth day	Wound dry on twenty-fourth day. Held one week for sounds	32	Cured
5	28	Abscess involves both lobes	Much pus	Suprapubic tube out on eighth day. Retention catheter out on nineteenth day. No residual urine on five examinations	Wound dry on twenty-eighth day	28	Cured
6	28	Abscess of both lobes. . .	No pus	Suprapubic tube out on third day. Retention catheter out on twenty-first day	Wound dry on twenty-fourth day	28	Cured
7	48	Abscess of both lobes. Operation on eighth day after admission	Much pus and much muco-bloody discharge from bladder	Suprapubic tube out on eighth day. Retention catheter out on twenty-ninth day. Wound breaks down on thirtieth day. Retention catheter in and was taken out on fortieth day. No residual urine in two examinations. Sounds passed easily	Wound dry on fortieth day	52	Cured

OPERATIONS FOR PERINEAL DRAINAGE OF PROSTATIC ABSCESSES

Case	Age	Pre-operative findings	Operative findings	Special treatment	Results	Days in hospital	Condition on discharge
1	25	Alcoholic abscess of right lobe. In for 6 days before operation	Much pus. Severe hemorrhage	Tube out on fifth day. Sounds 24 and on thirteenth day. Sounds many times following	Wound draining on twentieth day, second operation 10 days later. Wound again discharges urine on forty-second day	42	Fistula present. Patient passing urine through perineal wound. To return for third operation
2	36	Abscess of both lobes...	Much pus.....	Tube out on second day.	85 per cent. of urine passing through penis on thirtieth day	34	Small amount of urine by perineal wound. Home O. K.
3	35	Abscess involves the left lobe	Doubtful.....	Tube out on second day. 24–28 French sounds on fifteenth day	No urine by perineal incision on fifteenth day	20	Cured
4	44	Abscess of both lobes...	Pus found.....	Tube out on third day. Sounds seventh and twelfth days	Discharged on thirteenth day. Dry	13	Cured
5	39	Abscess of both lobes. Operation on sixth day after admission	Few gtt. of pus	Tube out on fourth day. 23 F sounds on seventh day; epididymitis on eighth day	No urine passed by perineum on eighteenth day	21	Cured
6	18	Abscess of both lobes...	Few gtt. of pus	Tube out on fourth day..	No drainage from perineum on tenth day	10	Cured
7	20	Abscess of both lobes...	No pus.....	Tube out on second day.	Leaking by perineal wound on seventh day	7	Discharged O. O. R. Home passing 80 per cent. of urine by perineal wound
8	44	Abscess of both lobes...	Much pus found	Tube out on first day after operation	Acute double epididymitis developed on seventh day; chills on seventh and eighth days	15	Home on fifteenth day. A. O. R. No leakage through perineum; epididymitis, subsided
9	39	Abscess of both lobes. Operation on tenth day after admission. Abscess and ruptured through	Large amount of pus	Tube out on fourth day. 25 F sounds on seventh and fourteenth days. Ophthalain test before operation 0 per cent.–20 per cent. After operation 4 per cent.–12 per cent.	No urine by perineum on fourteenth day. Slight urethral discharge is present	15	Cured, perineal wound healed
10	23	Abscess of both lobes...	No pus.....	Tube out on fourth day..	Dry on seventh day.....	7	Home cured. No leakage by perineal

I am greatly indebted to Dr. James R. Pinkston for the investigation of the subject of prostatic abscesses on the Urological Service at Bellevue Hospital, during the year 1917. These statistics show conclusively the advantage of the perineal over the suprapubic method of drainage for prostatic abscesses.

CHRONIC PROSTATITIS

There is a wide difference of opinion regarding the frequency with which chronic inflammation of the prostate occurs. Lagneau as early as 1815 called attention to the fact that chronic prostatitis occurred frequently as a complication of gonorrhœa. Verdier in 1838 gave the first accurate description of the pathology of chronic prostatitis. Montagnon, Eroud, Pezzoli, Casper and Wallach found chronic prostatitis as a sequel of gonorrhœal urethritis in from 70 to 94 per cent. of the cases. Hogge and Frank state that every case of posterior urethritis is complicated by prostatitis. Guyon and Fürbringer, on the other hand, consider chronic prostatitis a rare condition.

A careful study of my own series of 350 post-mortem specimens shows that there is evidence of inflammation of the prostates in a large majority of the cases.

Etiology.—Young, Geraghty and Stevens found that chronic prostatitis followed gonorrhœal urethritis in 73.2 per cent. of their cases, masturbation in 7.5 per cent., prolonged sexual excitement without coitus in four cases and withdrawal in 0.8 per cent., instrumentation 0.6 per cent., traumatism 0.8 per cent., infectious disease (influenza) 0.3 per cent., and no etiological factor determined in 14.8 per cent.

Bierhoff found that 57 of his 62 cases of chronic prostatitis were due to the gonococcus, the remainder showing a mixed infection. On the other hand, more careful studies by Porosz and Cohn lead them to believe that the gonococcus is not so frequently present in chronic prostatitis. Wassidlo, Schromm, Jadassohn, Ruggles, and Goldberg believe that a mixed infection is the usual finding.

My own observation is that following every case of posterior urethritis there is involvement of the prostate to a greater or less extent as manifested by persistence of *comma-shaped casts* of the prostatic duct orifices in the urine, nodulation and induration of the prostate and the occurrence of pus cells in more than the usual quantity in the prostatic fluid. The gonococcus is not usually found except very soon after the urethritis has subsided.

Prostatic Fluid.—The prostate gland is beyond question an organ essential to the virility of the male in all animals. The experimental work of Serralach et Parés has shown that there is an internal secretion which has a definite effect upon the other sexual organs. Removal of the prostate causes a cessation of activity in the testicles and seminal vesicles. Injection of a glycerin extract of the prostatic tissue prevented atrophy of the testicles and spermatozoa were given off in emissions in the normal manner.

Prostatic secretion is a milky fluid which has a penetrating odor and is alkaline or neutral to litmus and slightly acid to phenolsulphonephthalein.

Microscopically the prostatic fluid may consist of the following elements: Lecithin bodies, pus cells, epithelial cells, compound granular cells, corpora amylacea, erythrocytes, and spermatozoa.

The lecithin bodies vary in size from very small refractive points to bodies the size of a pus cell, and are most numerous in normal fluid, in fact, a comparison between the number of lecithin bodies to that of pus cells offers us a basis upon which to determine the degree of pathogenicity of the fluid being examined. It is my custom to estimate fluid upon a percentage basis. If the number of pus cells was so increased and the lecithin bodies decreased to the point where these two elements were about equal in number, one would say that the prostatic fluid shows 50 per cent. pus. If there were three times as many pus cells as lecithin bodies one would estimate the amount of pus to be 75 per cent., etc.

Epithelial cells are present usually but rarely to any great extent. Again referring to a percentage basis one usually finds that from 2 to 10 per cent. of the structures found in prostatic fluid are epithelial in type. They are the cells cast off by the lining mucosa of the prostatic ducts and tubules. *In situ* they are columnar, but as soon as they are cast off they assume a rounded appearance and are flattened.

In nearly every specimen of prostatic fluid will be found a few very large cells, epithelial in type and containing large numbers of globules, which vary greatly in size. These cells were first noted by Waldeyer, who described them as compound granular cells. They occur most often in old men, and may comprise as much as 5 per cent. of the structures, they are apparently degenerated epithelial cells.

Corpora amylacea are found most often in the prostatic fluid of old men, but may occur at any age after puberty. I have not observed them in specimens earlier than that.

Erythrocytes may occur in large numbers in a prostate which is too severely traumatized by massage, they are usually present in prostatic fluid expressed from a gland which is the seat of an acute or subacute inflammation.

Spermatozoa are frequently expressed with the prostatic fluid, due to pressure upon the ejaculatory ducts. These are usually very active when observed in the fresh specimen under the microscope because they are thoroughly mixed with prostatic fluid.

It is proper in treating a case of chronic prostatitis to make frequent microscopic examination of the fluid expressed by massage as it really indicates, more than does the palpating finger, the conditions present. Notthafft quite properly states that changes in the secretion are much more frequent than changes in the prostate, as noted by rectal touch, and he also points out that pus does not make its appearance in some instances until after the prostate has been massaged from two to five times.

I have noticed that frequently after a long period of massage the induration may entirely disappear and the prostate feel quite normal, but the

prostatic fluid will be loaded with pus. This condition may persist for some time, then pus suddenly disappears from the prostatic fluid and delayed cure will rapidly materialize ultimately.

It is our custom to stain the prostatic fluid at least once, usually at the first visit, in order to determine the presence or absence of bacteria.

The importance of the prostate as a focus of infection can not be over estimated. In my opinion it is second only to the tonsils as a cause of arthritis, and may frequently be the cause of endocarditis and neuritis. A number of cases of arthritis have been referred to me recently by an orthopædic surgeon, who, after eliminating the tonsils, teeth, and sinuses of the skull, has suspected the prostate.

I shall quote one case in detail as it is quite typical:

> J. J., stage carpenter by occupation, aged thirty-four, married, gave a history of a long siege of gonorrhœa about four years ago. He was apparently cured, and three years ago married. Three months before consulting me he had been exposed to some inclement weather and had had a severe polyarthritis which had affected the small joints of the feet, the ankles, and the knees particularly. He was confined to his bed for ten weeks and was able to hobble about with great difficulty. Upon physical examination his urine showed: Glass I, shreds, Glass II, clear, Glass III, comma-shaped shreds which were evidently casts of the prostatic duct orifices squeezed out in the last act of urination. Chemical examination of the urine showed no abnormality. Digital examination of the prostate per rectum revealed a gland about one-half the usual size indurated moderately throughout with several nodules near the base of the gland on each side. Many cord-like adhesions extended from each lateral surface to the surrounding pelvic structures, particularly at the base. The seminal vesicles were barely palpable on each side.
>
> Prostatic fluid expressed by massage showed it to be loaded with pus, practically no lecithin being present. There were a few epithelial cells and an occasional compound granular cell.
>
> He was given a prostatic massage every other day for two weeks. Following the massage he passed his urine and about 1 dram of 10 per cent. argyrol was instilled into the urethra with a very soft rubber catheter. He was able to return to his work, the treatments being continued for a period of two months, with the result that his joints cleared up so that he walks with only a slight limp, and is able to attend to all his arduous duties.

The signs and symptoms of chronic prostatitis are varied and in addition to the familiar pains in the back and morning drop one may meet with almost every degree of sexual disturbance always accompanied by neurasthenia. The pain is usually located in the small of the back, or may exist as a heaviness in the rectum. The latter type usually is accompanied by a history of the passage of prostatic fluid upon defecation. Pains may be referred down the backs or insides of the legs, or into the groins. It is

FIG. 1.—Abscess of prostate.

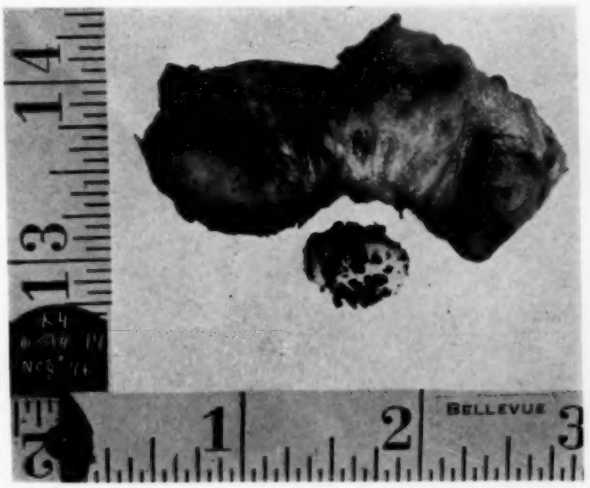

FIG. 2.—Enlargement of prostate and subcervical group; stone removed from bladder at time of operation.

FIG 3.—Enlargement of prostate and subcervical group of tubules (Dr. Barringer's case).

FIG. 4.—Other side of same specimen, showing marks of vesical sphincter on subcervical group.

not infrequent to have prostatic pains simulate the pain that accompanies renal calculus.

The urine practically always shows shreds, usually the comma-shaped ones which occur as casts of the prostatic duct orifice. Frequent and painful urination is usual and one may meet with hesitancy or precipitancy.

Rectal examinations will readily disclose the existing conditions. Chronic prostatitis is practically always accompanied by chronic seminal vesiculitis. The prostate is the seat of induration and nodulation and nearly always one may feel adhesions extending from the lateral border to the surrounding pelvic tissues and to the seminal vesicles; usually such prostates are enlarged and occasionally they may have boggy regions between the areas of induration. I never consider a case of prostatitis properly investigated unless a cystoscopic examination is performed, although I frequently postpone such examination until after the most distressing symptoms have been allayed by treatment.

Treatment.—The treatment of chronic prostatitis consists for the most part of prostatic massage followed by a cleansing of the urethra either by irrigation with silver nitrate or potassium permanganate solutions or by the passage of urine followed by instillations of argyrol, silver nitrate or other antiseptic solutions into the prostatic urethra. Every two or three weeks, the urethra is dilated with sounds or preferably by the Kollman dilator.

Thomas, of Philadelphia, in a recent publication has concluded that: (1) Chronic prostatitis may be and is at times a surgical disease requiring prostatectomy for its efficient treatment. (2) Chronic prostatitis is not infrequently associated with hyperplastic polypoid, papillary or nodular formations of the mucosa of the prostatic urethra and vesical orifice demanding removal by treatment coincident with that directed to the prostate. (3) Fulguration or the high-frequency spark promises to offer the best method of intra-urethral treatment for this purpose. (4) In the protracted cases of chronic prostatitis cysto-urethroscopy is always indicated and may be obligatory for proper diagnosis and treatment. Rarely will a case fail to respond to the palliative methods described above, provided the treatment is continued for sufficient length of time; hence, surgery of the chronically inflamed prostate should be a very rare outcome, although there are cases in which it would appear to be justifiable.

Tuberculosis.—Tuberculosis of the prostate does not occur with particular frequency. It is a disease of the young adult and usually occurs during the third or fourth decades. It is usually hæmatogenous in its origin, although it is not infrequent for it to accompany a tuberculosis of the epididymis and seminal vesiculitis in which case the lesions may be largely confined to that side of the prostate upon which the seminal vesiculitis exists, indicating that the disease may be borne by the lymphatics as well.

Wilson and McGrath found only seven cases of tuberculosis out of 468 patients studied, and call attention to the fact that the periphery of the lateral

lobes is the most frequent site of the disease, and not the neighborhood of the urethra.

In my own series of tabulated cases, which now numbers more than 500, I have observed about 10 cases of tuberculosis of the gland. Examination reveals a nodular elastic gland which is usually unilaterally affected and differs from the carcinomatous organ in that the latter is board-like in its consistency. The differential diagnosis may be extremely difficult, however, and I was allowed the privilege of examining a case with Dr. David W. MacKenzie, which I considered carcinomatous, and which upon removal proved to be tuberculosis of a low grade.

The tubercle bacilli become deposited in the walls of small capillaries, and tubercles develop. The bacilli are usually to be found in the borders of tubercles which extend in the usual manner.

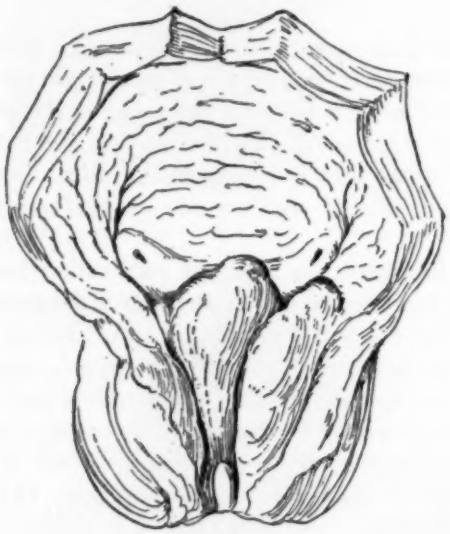

FIG. 5.—

Operations upon tuberculous prostates are to be performed but rarely, as resulting sinuses are the rule. Hallé and Motz recommend that even in cases of acute secondary abscesses no operation should be done.

Irving S. Koll has reported a case of primary tuberculosis of the prostate in which the gland was removed with apparent cure. He found two other cases in the literature.

Syphilis.—Syphilis of the prostate is an exceedingly rare occurrence. Although this dire disease seems to affect almost every other organ with more or less regularity, the prostate which harbors practically every other type of infection is graciously allowed to escape. I have not as yet come in contact with a single case of syphilis of the prostate gland.

Prostatism.—As Keyes points out, prostatism may be either sclerotic or adenomatous in type. A great deal has been written on this subject,

and recently Simpson, of Buffalo, has advanced the theory that the condition is caused by the growth of multiple adenomata; that these changes are most marked at the oldest part of the new-growth, and therefore correspond to such growth centers as have been demonstrated.

Simpson's discussion of literature is very complete:

"Virchow taught that the so-called hypertrophy should be separated into two classes, one belonging to the myomata, and the other to the gland tumors, from which we must conclude that he considered the enlargement of the prostate as a true tumor formation.

"Billroth wrote that in so far as his investigations went, prostatic hypertrophy was never connected with adenoma formation, but was a dilatation of the acini with perhaps some hyperplasia. He believed that nodular or diffuse myoma formation was common.

"According to Socin, prostatic hypertrophy is a name given to a variety of pathological conditions having in common the enlargement of this gland. In his opinion the ordinary enlargement is neither of inflammatory origin nor a true hypertrophy, but a true tumor formation.

"Cohnheim stands out definitely for the tumor theory, as may be concluded from the following: 'The new growth which one commonly calls hypertrophy of the prostate is neither inflammatory tissue nor, notwithstanding its name, legitimate hypertrophy, but true and undoubted tumor formation.'

"Laundis, a pupil of Guyon, did not consider senile prostatic hypertrophy as true tumor formation, but as a part of an extensixe arteriosclerotic process which begins in the kidneys and extends throughout the entire genito-urinary system.

"Rindfleisch assigned the cause of prostatic enlargement to tumor formation. He described two forms, the more rare fibrous, accompanied with atrophy of the glands, and the much more common form, namely, the discrete nodular adenomatous.

"Birch-Hirschfeld considered the enlargement of this gland as an expression of new-growth, and assigns its origin to the budding of the gland tubules.

"Lydston believed that prostatic hypertrophy began in the period of sexual activity and was the result in the majority of cases of sexual excesses.

"Jores called attention to the fact that apparently hypertrophy of the so-called middle lobe took its origin in the suburethral accessory glands.

"Aschoff demonstrated these suburethral accessory glands not only in males but also in females in the new-born.

"Ciechanowski wrote a voluminous article supporting the inflammatory theory of prostatic enlargement, particularly emphasizing the part played by gonorrhœa. He believed that a long continued chronic inflammation was the basis of the changes which take place in prostatic hypertrophy. He admits that true adenomata and myomata may occur rarely, but they have nothing in common with prostatic hypertrophy.

"Beginning with Albarran, the majority of French investigators (Motz and Perearnau, Marion, Marquis, and Chevassu) hold that prostatic enlargement is due to true tumor formation, their only difference of opinion being in regard to whether they take their origin from periurethral accessory glands or whether they may spring from any part of the gland itself.

"Stoker does not believe in the so-called middle lobe, but holds that the enlargements which occur at the proximal urethral orifice are caused by either myomata or adenomata. The enlargement of the gland proper he considers as a true hypertrophy, which may be associated with encapsulated adenomata.

"Rotschild advocated the inflammatory theory, and believed the enlargement was due to dilatation of the acini caused by obliteration of the excretory ducts. Bangs also upholds this view, although he believes that gonorrhœa plays little or no part in the

process, but would emphasize the factor of long continued congestion which occurs in long continued and often repeated sexual excitement.

"Wichmann, in an investigation of the etiology of prostatic enlargement, concluded that inflammation plays little or no part in the production of this condition.

"Wallace, Tietze, and Lendorf accept prostatic enlargement as adenoma formation, the latter holding that the tumors always spring from the periurethral accessory glands.

"Alexis Thomson, in a series of ninety enlarged prostates, wrote that he had never met with an encapsulated adenoma or fibro-adenoma and doubts if such exists. He believes the enlargement to be due to diffuse hyperplasia of both the gland and musculofibrous tissue.

"v. Frisch declares that we can only conjecture concerning the cause of these idiopathic tumor formations, the definite cause being unknown.

"Adami and Nichols teach that while prostatic hypertrophy may precede the development of definite neoplastic conditions within the organ, it must nevertheless be sharply distinguished from the same. 'With the more recent authorities we would regard it as the outcome of a long-continued, chronic inflammation, more particularly involving the urethral portion of the gland.'

"Simmonds, in Aschoff's Pathological Anatomy, writes that the more recent thought concerning hypertrophy gives a very subordinate place to the inflammatory, and considers the enlargement of the organ to be due to true tumor formation."

Tandler and Zuckerkandl's very thorough study on the subject is an exceedingly valuable research and discloses many features of great interest. They contend that hypertrophy of the gland always begins in the middle lobe which enlarges and compresses all other portions of the organ. As a matter of fact, my own studies have shown that the most frequent portion of the gland to enlarge is really a contiguous structure, the subcervical group of tubules. Enlargements occur in more than 23 per cent. of males over thirty years of age. This may occur without any enlargement of the prostate proper whatever. When the prostate itself enlarges there is usually a certain amount of enlargement of the subcervical group.

Adenomatous hypertrophy of the prostate occurs in both lateral lobes and the middle lobe most frequently—very rarely the anterior lobe may be affected. This has occurred four times in my experience. The posterior lobe is almost never the seat of this type of lesion. The portion of the gland which intrudes into the bladder is usually the subcervical group, which is recognized microscopically by the fact that there is very slight tendency of the mucosa to become heaped up and project into the lumina which are lined with many layers of cuboidal epithelium instead of the single layer of cylindrical epithelium which lines the prostatic tubules. Furthermore, there is not present the muscular envelope that is found in the prostatic tissue proper.

Rarely there is an intrusion of the middle lobe proper, in which case the trigonum vesicæ is thinned out, and the vesical sphincter is lifted up and so thinned out as to become obliterated. Frequently the subcervical group may be found imbedded in the middle lobe. The lateral lobes may also intrude in a similar manner, but the intravesical intrusion is usually merely reflected through the wall of the bladder and does not actually occur.

FIG. 6.—Enlargement of anterior or ventral lobe of prostate as well as both lateral and middle lobes.

FIG. 7.—True enlargement of middle lobe with the subcervical group imbedded in it. Vesical sphincter between the two strictures obliterated.

FIG. 8.—True enlargement of middle lobe of prostate (Dr. Frederick W. Smith's case).

FIG. 9.—Section of prostate, showing preponderance of interstitial tissue.

FIG. 10.—Cystic type of hypertrophy of the prostate, showing so-called "bridging."

FIG. 11.—Cystic type of hypertrophy of prostate, showing tendency of the cylindrical mucosa to degenerate. There are a few small corpora amylacea present.

FIG. 12.—Cystic type of hypertrophy of prostate; tubule denuded of its mucosa.

Subsequent to the enucleation of a true middle lobe intravesical intrusion the finger inserted through the vesical orifice will feel the gripping of the tissue. This may occur even though the sphincter muscles themselves are entirely obliterated by the middle lobe and is due to the elasticity of the capsule of the prostate, which contracts very considerably upon removal of the gland, and gives a sphincteric effect. The vesical sphincter is more or less dilated and its efficiency destroyed after any suprapubic enucleation of the gland, and is not usually affected by a perineal operation, as shown beautifully by X-rays taken of a thorium filled bladder after each procedure.

Non-malignant enlarged prostates present several types, considered from the microscopic standpoint: (*A*) The most common type met with is characterized by a dilatation of the tubules which are lined with a single layer of tall cylindrical cells with the nuclei near their bases. Usually the lumina show an intrusion of the mucous membrane in the form of papillary projections due to the proliferation of the mucosa. Frequently the lumina are so extended and the interstitial tissue so limited between tubules that the epithelial cells are situated on membranes which are placed back to back without either muscular or connective tissue cells intervening to any great extent. This process is commonly called "bridging" and has hitherto been explained by the statement that the mucosa has grown across and joined to that of the other side of the lumen. The thinning out process, due to marked distention of the individual branches of the tubules, however, seems to me to be the true explanation of this interesting condition.

(*B*) Further extension of this process results in the formation of cysts, usually small but sometimes so large as to occupy one-half of the enlarged prostate, as in a case recently operated upon at Bellevue Hospital by Dr. Alfred T. Osgood, in which most of the tumor disappeared upon opening into the lateral lobe of the organ; surrounding the groups of dilated tubules and their branches there is a layer of greater or less thickness, composed mostly of fibrous tissue, although in some instances there may be considerable smooth muscular tissue, shown by Van Giesen's method of staining.

There may be an unusual amount of fibrous tissue laid down, in which case the structure becomes (*C*) fibroglandular in type.

The latter may become very pronounced, in which case we have a large increase in the fibrous connective tissue or smooth muscle fibres or both, and have (*D*) the fibrous type with more or less compression of the tubular elements which do not then display the granular hyperplasia found in group *A*.

Surrounding the acini in all of the above-mentioned types of prostatic hypertrophy are found evidences of chronic inflammation. There is a marked infiltration of small round cells near the basement membranes of the prostatic tubules. This increase in cellular elements varies greatly in individual cases and in some instances causes a marked induration due to their presence in excessive numbers. The presence of this inflammatory tissue explains the occasional relief from symptoms sometimes met with

when a patient with an enlarged prostate refuses operation, and is given palliative treatment in the form of prostatic massage instead.

Exfoliation and other changes of the mucosa occur very readily in the prostate gland of the aged, and is noticeable in nearly every section of a removed prostate examined. In old age the prostate either becomes the seat of hypertrophy or atrophy. The gland practically never remains normal in size any more than it does in efficiency as compared with the normal gland of middle age.

In my series of autopsy specimens, I found that in the old-age period there was a deviation of some sort from the normal in 56 per cent. of the cases; 33 per cent. of the prostates of all subjects over sixty years of age showed a certain definite degree of adenomatous hypertrophy. Statistics gathered from the urological service at Bellevue Hospital, with the permission of Dr. E. L. Keyes, Jr., present some very interesting facts with regard to results of operations upon cases showing enlargement of the prostate and will be discussed fully in another communication.

Carcinoma.—At the present time investigators are unable to decide whether malignant disease generally is on the increase or whether our ability to diagnose malignant conditions is improving. Both conditions may be correct. The same thing applies to a consideration of prostatic malignancy as to cancer elsewhere. This is reflected in statistics reported at various times:

Fanchau found 5 carcinomata in 8289 prostates examined. Von Winiwarter discovered one prostatic cancer among 548 cases of carcinoma studied. Thompson (1854) published 18 cases which he had collected from the literature up to that time. Wyss (1866) added 10 cases, making 28 in all; Socin (1875) reported 50 cases; Kaupste (1885) 114 cases, Engelback (1888) 114 cases, Wolff (1899) 110 cases, Young 68 cases among 260 enlarged prostates. Belfield 10 per cent. of all hypertrophies. Wilson and McGrath, who collected above statistics, reported (in 1911) 73 cases among 468, or 15.5 per cent. carcinomata. Judd operated upon 93 cases, 21 in the sixth decade, 34 in the seventh, 36 in the eighth, and 2 in the ninth. Wilson and McGrath, in their earlier series of 73 cases, found: One between 40 and 50 years, 12 per cent. in the sixth decade, 40 per cent. in the seventh, and 41 per cent. in the eighth.

Carcinoma occurs more frequently as a primary growth, but may occur as a secondary implantation. Geraghty has pointed out that primary carcinoma of the prostate begins in most instances, 49 out of 50 cases, in the posterior lobe. This part of the gland is the only part which consistently does not take part in adenomatous hypertrophy of the prostate gland. The extension of carcinoma occurring in the posterior lobe is upward to the base of the prostate, where it involves the seminal vesicles, and only after it has ascended above the upper edge of the intervesicular fascia, described fully by me in another article, does it attack the rectum, being protected in

the region of the prostate itself by the fascia of Denonvilliers. The lateral and middle lobes of the prostate are, of course, involved rather soon in the development of the condition. Metastases occur quite early and are prone to attack the bones, more frequently than any other parts.

As Young and Geraghty originally pointed out, carcinoma of the prostate presents ordinarily a hard, tense structure which on pressure gives very little sense of elasticity and has, as we are in the habit of saying, a board-like rigidity. When cut with a knife one gets the same sensation that is imparted when one cuts cartilage. Irregularly interlacing bands of varying size are seen, with small grayish-yellow isolated masses which are collections of cancer cells.

Carcinomata of the prostate most often met with are the medullary types, although colloidal and melanotic cases have been reported. Keyes correctly states that no amount of epithelial proliferation within the acinus is evidence of carcinoma of the prostate; for these changes may be brilliantly illustrated in simple prostatism. There is a wonderful variation in the appearance of the tissues in adenocarcinomata. Being outlaws, of course, the cancer cells may show all variations in size and appearance in a single field. The acini are frequently much distorted and a break through the basement membrane with interstitial infiltration is invariably demonstrable. Scirrhus carcinoma shows a marked infiltration into the stroma of outlaw cells which may be gathered in nests or may occur in extensive rows.

Sarcoma.—Sarcoma of the prostate is a disease of the young and may occur so early and extensively as to lead us to the belief that it may have begun even before birth. Socin discovered a case in a child of eight months which involved the entire pelvic cavity, having evidently begun between the bladder and rectum. Bree reports a case nine months of age. Thirty-one cases were reported by Powers of which three occurred in children less than one year, 12 of the remainder were under eight years of age, 8 between fifteen and twenty-four years of age, and 6 between fifty and seventy years. Gibson in 1909 reported 2 cases of his own and tabulated 35 other authenticated cases.

An enlarged prostate occurring in a child or youth must be considered suspicious of sarcoma. These tumors grow rapidly and may involve the bladder and rectum and practically fill the pelvis in later stages.

Metastases are common to neighboring lymph-glands, lungs, liver, and frequently bones. Sometimes the urinary symptoms are entirely absent, but pain is a constant symptom. Indeed, these cases usually have to be kept under the influence of opiates constantly in later stages.

Histologically these tumors show great variation. Lagneu describes them as globocellular, fusocellular or composed of polymorphous cells. Certain tumors are composed of a variety of tissues, myosarcomata, angio-sarcomata, chondrosarcomata and rhabdomyomata. The commonest are the round-celled and the spindle-celled types.

Dr. F. J. Parmenter, of Buffalo, has sent me a specimen of the spindle-

shaped variety which he removed recently from a middle-aged man. Through the courtesy of Dr. Alfred T. Osgood, of Bellevue Hospital, I had the opportunity, some years ago, of following a case of spindle-celled sarcoma occurring in a young adult. At operation the prostatic tumor which had grown like wildfire was removed as a soft boggy mass. It promptly recurred and the patient died very soon thereafter.

An interesting case came to autopsy at Bellevue Hospital recently, in which a sarcoma originating in the prostate had invaded most of the vital organs of the body.

Prostatic Calculi.—The presence of stones in the prostate gland is a very common thing, met with probably more frequently by the pathologist than by the surgeon, because ordinarily they do not cause symptoms. In my study of a series of over 250 prostates of all ages, obtained from routine autopsies at Bellevue Hospital, I found that true prostatic calculi occurred inbedded in the gland with great frequency. I did not keep accurate records, but I should judge about 20 per cent. of the glands contained one or more calculi.

Calculi are quite frequently met with in sectioning adenomatous prostates for microscopic studies and are generally supposed to be due to a deposit of calcareous material in corpora amylacea.

One of my cases complained of difficulty in urination and apparently suffered no pain from the large number of calculi (325) which apparently filled every portion of the gland. One other case suffered from a prostatic abscess and the stones were removed in the course of the operation for that condition, which might have resulted from an acute infection accompanying the calculi.

I am under the impression that prostatic calculi are as a rule quiescent and rarely give rise to symptoms, although occasionally a stone may pass after prostatic massage, and abscess arising from or accompanying the condition will give rise to pain in the perineum. Routine rectal examinations and X-ray exposures will reveal many more calculi of this organ than we have been in the habit of observing. The urinary and sexual symptoms are those which one usually finds in any chronic inflammatory condition of the gland.

Most of the cases reported have shown the presence of a few calculi. Two of my cases are interesting in that one of them had 325 stones in the prostate and the other 126.

Kretschmer has made studies of the composition of many calculi and states that "They consist in the main of phosphates, carbonates, or oxalates of lime, or magnesia or triple phosphates."

Lassaige (quoted by Glasel) gives the following composition of primary stones: Calcium phosphate, 84.5 per cent.; calcium carbonate, .5 per cent.; organic material, 15 per cent.

Dupuytren (quoted by Glasel) gives the composition of four stones obtained from a patient aged forty-one, as follows: Calcium phosphate, 60 per cent.; ammonium magnesium phosphate, 20 per cent.; calcium car-

bonate, 20 per cent. The stones from Kretschmer's own cases consisted of calcium oxalate with a small amount of unidentified organic detritus in one case, calcium carbonate and calcium oxalate in another.

It is important in interpreting röntgenograms of this region to remember that the large veins on the ventral and lateral surfaces of the prostate gland making up the plexus of Santorini are particularly prone to harbor phleboliths, as I have pointed out in a previous article.

In removing prostatic calculi in young men not suffering from adenomatons hypertrophy the perineal exposure practiced by Young is the operation of choice. By painstaking effort the calculi may be removed through the lateral slits and most of the acini of the prostate left *in situ*. In one of my cases reported recently the prostate two years after the operation is apparently free from recurrent or overlooked calculi and is performing its intended function in an entirely satisfactory manner.

Calculi coincident with adenomatous hypertrophy of the prostate are removed with the gland itself and those which are quiescent and discovered by accident should be left alone.

LITERATURE

Young, Geraghey, and Stevens: Johns Hopkins Hospital Reports, vol. xiii, p. 272.

Albarran and Cottel: xiii International Congress of Medicine, Paris, 1900.

Cohn: Centralblatt f. die K. d. h. und S. O., 1898.

Bierhoff: Medical News, October, 1904.

Porosz: Monatsberichte f. Urolgie, 1903.

Serralach et Pares: Quelwues douness sur la Physiologie de la prostate et du testicus, Cirihi Soc. Biol., December 28, 1907.

Notthafft: Derin und Syph., 1904.

Herman L. Kretschmer: Trans. of the American Urological Assoc., 1917, vol. xi, pp. 151-177.

Thomas, B. A.: Chronic Surgical Prostatitis. Transactions of the American Urological Assoc., 1917, vol. vi, pp. 5-13.

Wilson and McGrath: Surg., Gynecology and Obstetrics, December, 1911, pp. 647-651.

Irving S. Koll: Trans. American Urol. Assoc., 1915, vol. ix, pp. 367-370.

Neuber: Zeitschr. f. Urol. Chir., 1910, ii, 405.

Powers: ANNALS OF SURGERY, January 27, 1908.

Bree: Medullary Sarcoma of the Prostate. The Proviue, Med. and Surg. Journal, 1846.

Gibson: Trans. Amer. Assoc. of G. U. Surgeons, 1909. Tabulates 37 authenticated cases, two of which are his own.

Rochet: Rev. de Chir., 1908, xxxvii, 397.

Pousson: A propos de deux Cas de colcula endaprostatiques Assoc. franc. d. urol., 1911, 725; Precisde mal. Urin. 2nd ed.

Socin and Burckhordt: Die Verletzungen und Krankheiten der Prostata. Stuttgart, 1902.

Fanton, J.: La lithiase prostatique Rev. clin. d. urol.; 1912, pp. 12-25 and 141-50.

Albarran, J.: Concretions et calcula de la prostate, Le Deutie et Delbert Traite de Chir. et op., 1898, ii, 578.

Kretschmer, J. L.: True Prostatic Calculi. Trans. Amer. Urol. Assoc., p. 151.

Crosse, John G.: Treatise on the Formation, Constituents and Extraction of Urinary Calcules, 1835, London, p. 33.

Glasel: Calculi prostatici veri-ztschr. f. urol. chir., 1914, ii, 353.

THE HUMAN SEMINAL VESICLES AT BIRTH—WITH OBSERVATIONS ON THEIR FETAL DEVELOPMENT*

By Ernest M. Watson, M.D.
of Buffalo, N. Y.
(From the James Buchanan Brady Urological Institute, Johns Hopkins Hospital, Baltimore, Md.)

The basis for this report was obtained from the study in serial sections of the genito-urinary tract of a male fœtus at birth. The sections were cut 40 micra thick, stained in the usual manner in hæmatoxylin and eosin and every section from the urachus to the anterior urethra saved for study. In addition a reconstructed drawing was made from 120 serial sections magnified twenty-five times on millimetre paper to give a graphic representation of the outline of the seminal vesicles at this stage.

In this specimen of a normal human fœtus at birth the vesicles appear as well-developed paired sacculated organs, the lower borders of which are situated at the upper boundary of the prostate gland between the bladder and rectum. The left measures 4.75 by 3.75 mm. in diameter, having its greatest length perpendicularly or anterior-posteriorly, and the right measures 4 mm. by 4.7 mm. and has its greatest diameter extending laterally from the ampulla of the vas. The upper boundary or tip of each vesicle reaches just below the lower limit of the trigone close to the lower boundary of the ligamentum interuretericum. At its uppermost extremity the lumen of each vesicle is less than one-half the diameter of the Wolffian duct or vas deferens in cross-section at the same level. This relation soon changes in the succeeding sections, however, until we have a several-cavitied vesicle each lumen of which is from three to five times the diameter of the vas.

On macroscopic inspection each vesicle is a somewhat soft, lobulated body rather firmly enclosed in a fibrous tissue sheath which obscures much of the finer detail of interlobular structure and arrangement. In this specimen at birth the true peritoneum reaches just below the tip of each vesicle while the body proper of the vesicle is in close approximation with the rectum. This relationship persists until its lower third is reached where there is encountered that remnant of peritoneum, the so-called fascia of Denonvilliers, which is firmly attached to the vesicles and continues further down to cover the posterior or dorsal aspect of the prostate gland.

On cross-section the walls of the vesicles are made up of an inner lining of a single layer of somewhat cuboidal epithelium, beneath which is a definite basement membrane. This is supported by a few strands of thin fibrous tissue, the tunica propria, which is in direct contact with the muscular coat or wall. This muscle layer is nearly .5 mm. in thickness,

*Read before the Section on Genito-urinary Diseases of the American Medical Association, June, 1918.

is everywhere circular in arrangement and of the smooth muscle type. Beyond the muscle layer is encountered a fibrous covering, the tunica adventitia, which envelops the entire vesicle, with a few strands extending in between the separate cavities. Each vesicle presents an extremely irregular outline, being composed of numerous outpushings of diverticula of varying depth and diameter. These for the most part are confined to the distal and middle thirds of each organ. The inner third, or that portion which joins the Wolffian duct, termed the proximal canal, is pretty generally free from any appreciable number of diverticula. The evaginations or outpushings arise not only from the main channel of the vesicle itself but in some instances from other evaginations. On the whole, the picture is one of an almost tree-like growth with the branches of finger-like processes proceeding from the middle and distal thirds of each organ and growing for the most part in an upward direction. Each branch or diverticulum ends as a blind pocket, but in every instance its lumen is patent throughout its main cavity and at its union with the proximal canal, the vesicle proper or with another and larger diverticulum.

From this arrangement it is seen that the drainage is in the main downward and follows the natural path of gravitation. As the distal extremities of the diverticula certain angulations are met with in many instances which unquestionably lend themselves as ready sites for a stasis of their contents, and particularly is this true if at their point of origin from the larger diverticula or proximal canal there is a narrowing of their lumina from congestion, swelling and the usual results of inflammation. With this antomical picture it is seen that in order to obtain efficient drainage by surgical intervention multiple incisions are necessary and these for the most part should be made along the middle portion of the organ and particularly at the apex or tip of each vesicle where angulation with an anatomical tendency to pocket formation is great. In addition to the diverticula or finger-like processes mentioned above as arising from the proximal canal and vesicle proper, there are many smaller cup-like evaginations or depressions which have been termed saccules. These arise from the walls of the various pouches and also from the vesicle itself and add greatly to the irregular and ragged contour of each organ yet present no added consideration from the standpoint of drainage because of their very shallow character. Many of these saccules as well as numerous less well-defined depressions are supported by a definite framework of reticulations which gives the picture of an almost honeycombed structure when seen in cross-section. This arrangement is more common along the distal or upper third of each vesicle.

Careful study of the origin and course of the various finger-like evaginations arising from the vesicle have shown that in this specimen the vesicles are truly well balanced paired organs having ten definite diverticula or pouches entering into the formation of the vesicles on either side. This fact could be determined with certainty only on the reconstruction from successive serial sections of the form and outline of the vesicles under

suitable magnification. In no instance in this specimen was the lumen on point of origin of any diverticulum found congenitally occluded or appreciably narrowed from the normal picture.

As has been described in detail elsewhere[1] the first indication of the origin of the seminal vesicles occurs during the thirteenth week of fetal life as lateral out-pocketings of the walls of the Wolffian ducts just above the first observed tubules of the prostate gland. This evagination of the walls of each duct carries with it the mucous lining and basement membrane and is surrounded by a mass of undifferentiated mesenchymatous cells in all respects similar to the Wolffian duct itself. Definite furrows of constriction are encountered even at this early stage marking the union of the vesicle and Wolffian duct. This constriction gives the vesicle an almost pedunculated appearance. At its first appearance the vesicle measures 1/68 by 1/200 mm., having its greatest diameter extending laterally from the Wolffian duct.

By the fourteenth week the organs have grown very appreciably in size and have become V-shaped or bifurcated at their distal extremities. Their growth for the most part has been lateralward from the Wolffian ducts. The branching of the tip of each vesicle is the first indication of diverticula formation, which phenomenon, however, is noted at other sites along the vesicle proper by the beginning irregularity of its walls and to a lesser extent along the inner third of the organ which portion has been termed the proximal canal. The histology of the vesicles has not changed perceptibly during this growth except to show a more close approximation of mesenchymatous cells about the basement membrane, which grouping shows a little deeper staining reaction. The vesicles now measure 1 by .5 mm. in diameter.

At the sixteenth week the vesicles have increased very definitely in size over the preceding picture, but their general configuration remains the same. The growth has been for the most part in a perpendicular direction along the path of the Wolffian ducts. The distal extremities are still forked and along the body of the vesicle proper there is a still greater tendency to irregularity but no definite additional diverticula have appeared. The vesicles here join the Wolffian ducts at an angle of 45 degrees, while in the earlier specimens they appeared as direct lateral outgrowths at an angle of 90 degrees. They measure at this time 1 by .75 mm. in diameter.

By the nineteenth week there has been a notable increase in the number and size of their diverticula. At this time can be counted seven well-defined finger-like processes entering into the formation of the left vesicle and five similar diverticula branching from the right vesicle. These in general are confined to the distal thirds of each organ. The proximal canal still remains as a definite entity but shows a moderate increase in irregularity. At this time is noted a dilatation of the Wolffian ducts with some slight irregularities

[1] Watson: "The Development of the Seminal Visicles in Man." *Amer. Jour. of Anatomy*, 1918. "The Developmental Stages of the Human Seminal Vesicles." *The Jour. of Urology*, vol. ii, No. 2, p. 129, April, 1918.

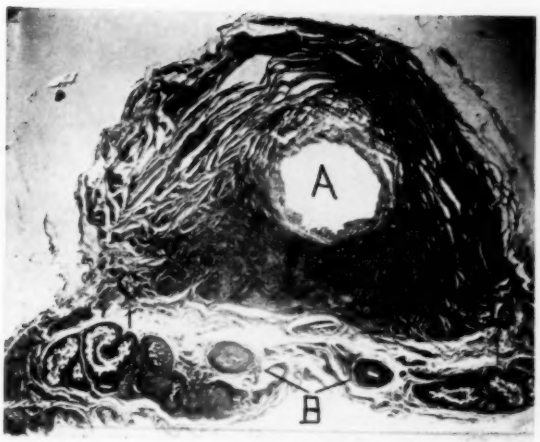

FIG. 1.—Cross-section through the seminal vesicles, vasa deferentia and bladder. Fœtus at birth. *A*, bladder cavity; *B*, vasa deferentia; *C*, left seminal vesicle; *D*, right seminal vesicle.

FIG. 2.—Cross-section through the left seminal vesicle and left vas deferens. Fœtus at birth. *A*, Five cavities of the vesicle showing at one level; *B*, left vas deferens.

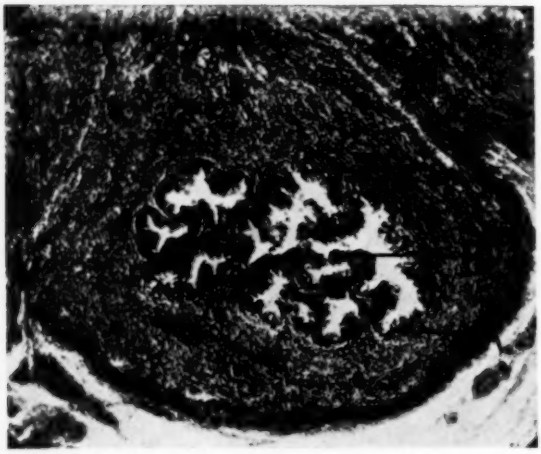

FIG. 3.—Cross-section through the distal portion of a single cavity of the vesicle showing the saccules and reticulated framework. Fœtus at birth. *A*, Saccules; *B*, reticulated framework.

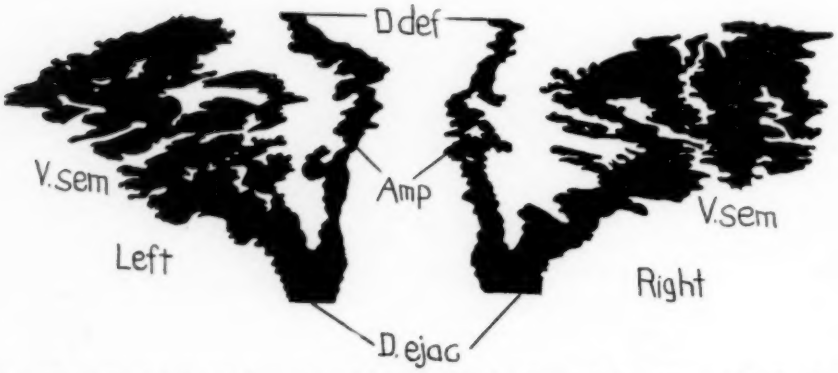

FIG. 4.—Reconstructed drawing from 120 serial sections showing the seminal vesicles and Wolffian ducts. Fœtus at birth.

indicating the onset of changes incident to the formation of the ampulla of the vas.

At the twenty-first week the striking picture is the overlapping and fusing of the elongated finger-like processes described in the previous stage. By this fusing is not meant a joining of the individual lumina but rather an alignment of two or more diverticula within the same outer fibrous sheath. This has taken place with only a moderate increase in the size of the vesicle, which arrangement gives an impression of wider and larger outpocketings which in reality are only superimposed diverticula. At this time nine well-developed branches go to make up the body of the left vesicle, while seven similar outgrowths enter into the formation of the right vesicle.

The development at the twenty-fifth week shows a still greater degree of overlapping and fusing of diverticula within a single fibrous sheath. This has taken place with no marked additional change in their gross architecture. The vesicular walls are now well formed and are composed of a definite musculature. In addition the region of the ampullæ shows considerable irregularity and dilatation. Each vesicle in the specimen studied at this stage is composed of five well-formed branches which make the vesicles well-balanced paired organs.

The interval between the twenty-fifth and thirty-first week of intrauterine life is the period of greatest growth, and at the latter time may be counted ten well-developed elongated evaginations entering into the formation of each vesicle. These diverticula are very irregular in outline and in lateral view give the effect of a very complexly branched tree. The locations of the elongated processes of growth occupy a position as indicated in the earlier specimens, namely along the middle and distal thirds of each vesicle, and in the main grow in an upward or perpendicular direction. This gives each vesicle an alignment almost parallel to the axis of the accompanying Wolffian duct on either side. At this time the ampullæ are well dilated and from each arise several sacculated finger-like processes in all respects of a kindred form and structure to those arising from each vesicle proper.

Between the thirty-first week and birth there occurs no appreciable increase in the size of the vesicles but the growth is rather an increase in the complexities and ramifications already present. It is during this interval, however, that the inner reticulated framework supporting the middle and distal portions of the vesicular walls is noted and in addition the smaller saccules make their appearance.

TRANSVERSE ECTOPY OF THE TESTIS WITH MASCULINE UTERUS

By T. Kimura, M.D.
of Kyoto, Japan
(From the Surgical Department of the Prefectural Medical College of Kyoto)

Congenital displacement of the testis is not rare, but most of the cases are that of imperfect descent, namely, abdominal and inguinal. The transverse ectopy, however, of the testis, which Lenhossék first reported in 1886, is very rare. Since his report, according to my collective investigation, ten like cases have been found. Before describing a case that was under our observation, I desire briefly to summarize those collected from the literature.

CASES REPORTED IN THE LITERATURE

Case I (Reported by Michael V. Lenhossék in 1886).—The patient was a man aged thirty-five years, whose testicles lay on the left side of the scrotum and were of equal size. The two vasa deferentia were connected with connective tissue and passed together through the left inguinal canal, where they turned and reached the upper edge of the prostate, when they first divided—the left going directly to the normal left seminal vesicle, the right making a rectangular curve before uniting with the right seminal vesicle.

Case II (Reported by Max Jordan, 1895).—A boy eight years of age, with both testicles in the left side of the scrotum, each of them having its own tunica vaginalis. The vasa deferentia soon connected and for the most part formed one canal. The patient had left inguinal hernia and hypospadias.

Case III (Reported by Paul Linser, 1901).—A boy two and a half years of age with both testicles imbedded in the posterior cystic wall of the right scrotum. They were equal in size, appeared normal and were enveloped with the same tunica vaginalis. Both vasa deferentia were independent and not united to the bladder. The patient had a right scrotal hernia.

Case IV (Reported by A. A. Berg, 1904).—A boy aged thirteen years, with a large scrotal hernia on the left side from birth. Both testicles and cords were intimately connected with the hernial sac on the left side. The testicles were of unequal size but appeared normal. Both cords passed through the left inguinal canal. The cord of the smaller testicle passed through the left inguinal ring, crossed the space of Retzius, to the right inguinal region; thence it descended to the pelvis. The cord of the larger testicle descended on the left side of the bladder to the pelvis.

Case V (Reported by A. L. Halstead, 1905).—A man, aged thirty years, who was operated on for a left congenital irreducible inguinal hernia, had both testicles on the left side of the scrotum. The cord contained two vasa deferentia, two spermatic arteries, and two sets of veins, enclosed in one vaginal process. This double cord passed through the left inguinal canal. The right side of the scrotum and the right inguinal ring were empty.

Case VI (Reported by R. Romanovsky and J. V. Winiwarter, 1905).—A male, sixty-one years of age, with both testicles in the left half of the scrotum, enclosed in one tunica vaginalis propria. The left testicle was greatly malformed and lay at the bottom of the sac. The misplaced right testis was situated above it and was slightly

less malformed than the left. The left spermatic cord passed normally, but the right crossed the median line and descended to the right seminal vesicle along the back wall of the bladder.

CASE VII (Reported by Cornil and Bossard, 1907).—A boy nineteen years of age, in whom the external genitals were normal, was found at operation to have a tumor in the tunica vaginalis, which was extirpated. There was a hypertrophic uterus 9 cm. long, with two fallopian tubes. A testicle was suspended at the end of one tube, and another at the uterine cornu of the opposite side.

CASE VIII (Reported by D. Castelli, 1909).—A man twenty-three years of age, in whom, at operation, two testicles were found on the right side of the scrotum; the left half was empty.

CASE IX (Reported by A. Duse, 1910).—A man, aged twenty years, with a diagnosis of inguinal hernia, was operated on, and both testicles and a masculine uterus with a single fallopian tube were found in the right half of the scrotum.

CASE X (Reported by H. Iwasaki, 1912).—A man, twenty-four years of age. There were two testicles on the right side of the scrotum and the left half was empty. Between the two testicles was found a soft lump the size of a testis, connected with both testicles by fibrous membrane. The right spermatic cord passed up through the right inguinal canal, and the cord which belonged to the misplaced left testis came out on the inner side of, and underneath, the right outer hernial ring, passed down through the soft lump and was covered with the tissue of the vaginal process. The patient had suffered from right inguinal hernia.

CASE OBSERVED IN THE HOSPITAL OF THE PREFECTURAL MEDICAL COLLEGE AT KYOTO, JAPAN

CASE XI.—K. T., a male student, aged twenty years, was admitted to the hospital October 7, 1914. Five months after birth, a swelling was noticed on the left side of the scrotum. The doctor who was consulted diagnosed hernia and applied a truss, which appeared to cure the hernia. When the patient was five years of age, the left half of the scrotum swelled suddenly during play and was reduced by taxis. September 5, 1914, he noticed swelling, not painful, of the left side of the scrotum. October 1, the swelling developed rapidly, the skin became red, and the patient suffered with pain and had no appetite. This condition was followed by nausea and vomiting. The physical examination revealed a medium-sized and well-nourished youth. The elasticity of the skin was normal. The face was anxious and its color was pale. The tongue was slightly coated. The temperature was 39° C., and the pulse was about 80 and of normal tension. The lungs and the heart were normal. The abdomen was slightly distended, but there were no abnormal peristaltic movements. The liver and kidneys were not palpable. Extending from the left inguinal region to the scrotum of the same side, there was general swelling, and the left half of the scrotum was as large as the fist of an adult. The skin over it was red and smooth. Anteriorly and below, fluctuation was elicited; on percussion, there was dullness and with illumination it was translucent. At the upper part of the left side of the scrotum there was a mass tender to the touch and extending upward to the inguinal canal as a cord twice the size of the thumb. Neither testicle could be touched from the outside. A diagnosis was made of incarcerated hernia.

Operation (October 7, 1914).—Performed under general ether anæsthesia. An oblique incision about 15 cm. long was made through the skin

along the left inguinal canal. On opening the subcutaneous adipose tissue and fascia, a brown-colored tissue, resembling a hernial sac, was discovered. When this was dissected out, about 30 cm. of serous fluid of the same color flowed out and showed the omentum adherent to the sac. The intestines were not found. Because it was discovered that the sac communicated with the peritoneal cavity, an opening was made through the inguinal canal and a part of the peritoneum. There was a small amount of translucent and pale yellow fluid in the peritoneal cavity. No special change of the intestines was discerned. Just beneath the adherent omentum was a thick, firm cord which extended downward to the distended scrotum, upward deep in the pelvic cavity, and behind and underneath the bladder. There was no connection of the cord with the intestines. About 150 cm. of yellow, translucent and somewhat gluey fluid flowed out when at attempt was made to dislocate the testicle. This cord, the spermatic cord and the omentum had grown intimately together, with adhesions so dense that attempts at isolation were abandoned. Near the internal inguinal ring the three tissues were amputated and, with the contents of the left side of the scrotum, extirpated. The amputation stump was carefully sutured, because the stump of the cord had a lumen and its inner surface was covered with a tissue like the mucous membrane. After the peritoneum was closed, the wound was partially closed and a small drain inserted.

The day after the operation, vomiting ceased. During the five days after operation, the temperature was 38° C. to 39° C. daily; after that time, the fever disappeared gradually and appetite improved. November 25, the patient left the hospital. The wound was healed, except for an area 2.5 cm. in diameter. The scrotum on the affected side was empty. On the right side, a fine fibrous band came down from the inguinal canal; its lower portion was slightly thickened and attached to the bottom of the scrotum. Pressure upon it gave no testicular sensation. Nothing in the band could be found which resembled the seminal cord. Rectal examination with the finger through the anal canal revealed no special abnormalities.

Pathologic examination (gross specimen) showed a thick-walled cyst, two spermatic cords and a cylindrical mass of tissue with a canal which was lined with mucous membrane. When the cyst was opened, two testicles were found, one of which occupied the upper part of the sac, the other lying in the bottom of it. Both testicles were of normal size and appearance and were situated in the horizontal plane with their major axis. Between them was neither septum nor membrane. Each testis had its own epididymis and normal sized spermatic duct. These ducts were accompanied by the spermatic arteries and veins and formed spermatic cords which were held together 3 cm. apart by connective tissue. The canal, the wall of which was 0.5 cm. thick and its lower end terminating in cæcal form, was between the cords.

Microscopic specimens were made of both testicles and of a transverse section of the canal, including spermatic cords. The examination showed two spermatic ducts, accompanied by their own spermatic arteries and veins. The inner surface of the ducts was lined with a cylindrical epithelium. No pathologic change was noted in the duct wall. The blood-vessels were generally congested; in some of them the lumen was only dilated, in others the middle coat was more or less thickened. There was no perceptible thickening of the tunica intima or narrowing of the lumen.

The inner surface of the sac which terminated in cæcal form was lined by one or two layers of cylindrical epithelium with cilia. Just beneath these epitheliums was a stratum of fine fibrous tissue, in which were contained many connective-tissue cells, a small quantity of homogeneous intermediate tissue, and many leucocytes. In addition many fine, dilated, congested blood-vessels and glands, lined with one layer of cylindrical epithelium, were found. These vessels and glands were irregularly arranged. The tunica propria was connected directly to the muscularis. The submucosa was absent. The muscularis consisted of smooth muscular fibre, the course of which was somewhat irregular, so that sharp limitation of the individual layer, such as in the bowels, was impossible. However, in general, three layers could be differentiated: an inner layer of longitudinal fibres adjoining the tunica propria, a middle circular fibre layer, and an outer longitudinal layer. The muscularis adjoined the fibrous tissue of the spermatic cord. Here and there was a small amount of inflammatory cell infiltration. In short, the structural appearance, microscopically, resembled that of a uterine wall, not that of an intestine or a Meckel's diverticulum. Microscopic sections of the testicles showed that the free surface of the tunica albuginea was covered with one layer of pavement epithelium, as usual, and that both testicles were normally developed.

Discussion.—Considerable difference of opinion exists as to how the transverse ectopy of the testis is brought about. Lenhossék explained the condition as follows: "The abnormality may depend either on a faulty development of both testicles in one side, or on a faulty descent of the testis, due to the abnormality of the gubernaculum testis." He said that for his case, in which both spermatic cords ran close together, the first hypothesis is plausible. Jordan joined in Lenhossék's explanation and states the view that his case was caused by the union of both Wolffian ducts on their distal part. Linser remarked that it was inconceivable that a testicle which was originally in a normal position should pursue such an abnormal course in its descent. He expressed the same view as Lenhossék—that it was the faulty, one-sided origin of both testicles—because in his case both testicles were equally developed and held in a common tunica vaginalis. On the contrary, in the case of Romanovsky and Winiwarter, the spermatic duct of the displaced testis had its origin from the right side and, for the most part, followed the right half of the body, and the gubernaculum Hunteri which belonged to the right testis passed through the right inguinal canal. From these facts, the authors inferred that the right testis must have been either pressed to the left side or taken with the left testis into the open processus vaginalis because of some abnormal connection. At the moment of the commencement of this deformity they state that the right testis must have passed through the inguinal canal before the physiologic closing of the left processus vaginalis.

Under such circumstances, we know that there are two different points of view respecting the mode of origin of the transverse ectopy of the testis. I believe the cause of this disagreement to lie in the fact that each author's explanation was based on his own simple case, the anatomic conditions being

different in every case, because the deformity is very rare. When both spermatic ducts pass through one side of the body absolutely, as in the case of Lenhossék and Linser, it may be recognized as a faulty development of both testicles on one side. There are some cases of similar transposition of other symmetric organs, as, for instance, the kidney. Stocquart reported a case in which a double kidney with two ureters was found on one side of the body, and none on the other. On the contrary, if one spermatic duct, after passing through the same internal ring with the other, crossed the median line and descended to the seminal vesicle on the other side, while the other duct took a normal course, it shows that a testicle has been displaced during its descent to the other side.

It is much to be regretted that in our case the inside of the pelvic cavity could not be examined deeply, because the patient was feverish under the symptoms of incarcerated hernia, and at the time of the operation a brown-colored serous fluid in the hernial sac and a canal of tissue lined with mucous membrane were found. Therefore, an unquestionable decision in regard to the case cannot be given. Each testicle was covered with its own tunica propria, and from each of them a normal-sized cord with its spermatic artery and veins passed upward. From this fact it is inferred that the rudiment of a testicle was originally on each side, but at the beginning of the fetal period, there occurred an error of development in a part of the Wolffian duct, owing to a loose adhesion between the testes, and thus both testicles descended on the left side of the scrotum. There is no doubt that a tissue which has a structure resembling the wall of the uterus is a masculine uterus developed from persistent Mueller's ducts. Doctor Tsunoda, of the pathologic department of our college, who inspected the specimen, was of the same opinion. Cornil and Brossard observed, in a man, a uterus with two fallopian tubes and two testicles. Duse noted a uterus unicornis with a single fallopian tube which was between the two testicles. The reason for the existence of such a masculine uterus may be explained as follows: originally, Wolffian ducts and Mueller's ducts run parallel to each other. In the male the former develops continuously, while the latter diminishes by degrees after the tenth embryonal week. But, if from some cause a part of Mueller's ducts remains behind and develops further, then there may occur a so-called masculine uterus.

REFERENCES

Berg, A. A.: Transverse Ectopy of the Testis. Ann. Surg., 1904, xl, 223-224.

Castelli, D.: Su di una rara eterotopit testicolare. Riforma Med., 1909, xxv, 1325-1328.

Cornil and Brossard: Utérus et trompe situés entre les deux testicules, dans la tunique vaginale. Bull. de l'acad. de med., 1907, No. 34.

Duse, A.: Utero mascolino erniato con distopia transversa del testicolo sinistro. Clin. Chir., 1910, xviii, 1597-1606.

Halstead, A. E.: Left Inguinal Congenital Hernia, with Two Testes on the Left Side. Trans. Chgo. Surg. Soc., May 1, 1905; Ann. Surg., 1905, xlii, 785-786.

Iwasaki, Y.: A Case of Dystopia Testiculi. The chugai Iji Shimpo, 1912, 770 (Japanese).

Jordan, M.: Ein Fall von einseitigen Descensus testiculorum (Ectopia testis transversal). Beitr. z. klin. Chir., 1895, xv, 245.

Lenhossék, v. M.: Ectopia Testis Transversa. Anatom. Anz., 1886, i, 376.

Linser, P.: Ein Fall von Dystopia testiculi transversa. Beitr. z. klin. Chir., 1901, xxix, 381.

Romanovsky, R., and v. Winiwarter, J.: Dystopia Testis Transversa. Anatom. Anz., 1905, xxvi, 635-639.

Stocquart, A.: Observation anatomique d'un cas de symphysie rénale. Virchow's f. path. Anat., 1879, lxxviii, 244-249.

GIANT-CELL GROWTH OF BONE AND TENDON SHEATH

GIANT-CELL SARCOMA, BENIGN MYELOMA, ETC.

By Leonard W. Ely, M.D.

of San Francisco

(From the Stanford University Laboratory of Surgical Pathology)

Giant-cell growths in bone and also in tendon sheaths are fairly frequent. In a rather thorough search I have not found a case in which bone and tendon sheaths were involved in the same patient. Following is the history:

Mrs. D., aged twenty-seven, March 15, 1916. The patient has been married eight years, and has one child eight weeks old. She has had no miscarriages and has always been healthy. She sprained her right ankle three years ago, and the injury was followed by complete recovery. One year ago she sprained the ankle again. It has been painful ever since, and somewhat swollen, although it did not grow much worse. Four months ago it was sprained again. Since the birth of the baby the patient has been much worse. She has been on her feet more. She is nursing the baby and is feeling well, but thinks she has lost weight during the past week. She gives no history of sore throat, and her husband denies lues.

Examination.—The patient limps. She has a rounded, obscurely elastic swelling of the lower end of the right fibula, somewhat sensitive to firm pressure, but not accompanied by any inflammation. A small, rather firm swelling is present below the lateral malleolus, not connected with the main tumor. The veins are dilated over the swelling.

The X-ray picture shows a marked enlargement of the bone, with thinning of the cortex.

Operation (March 17).—Esmarch bandage. The incision was a longitudinal lateral one over the lower end of the fibula, laying bare the very thin shell of bone. This thin shell was opened, and some of the contents were scooped out. They correspond to the description ordinarily given of giant-cell tumors, except that they were more reddish brown than red.

Professor Ophüls made a frozen section of the material, and pronounced the growth a giant-cell sarcoma. The incision was then prolonged distalwards, over the small mass below the malleolus. This mass, about the size of a bean, firm and rather elastic, was dissected from the peroneal tendon sheath, and the sheath was opened in the operation.

The cavity in the fibula was then scooped out thoroughly, and the thin lateral shell of bone was removed. Two more fairly large masses were discovered, and were dissected from the peroneal muscle and tendon sheath immediately behind the bone tumor but apparently not connected with it or with the other growth dissected from the tendon sheath. The cavity in the bone was swabbed out with alcohol and

FIG. 1.—Skiagram of growth in fibula.

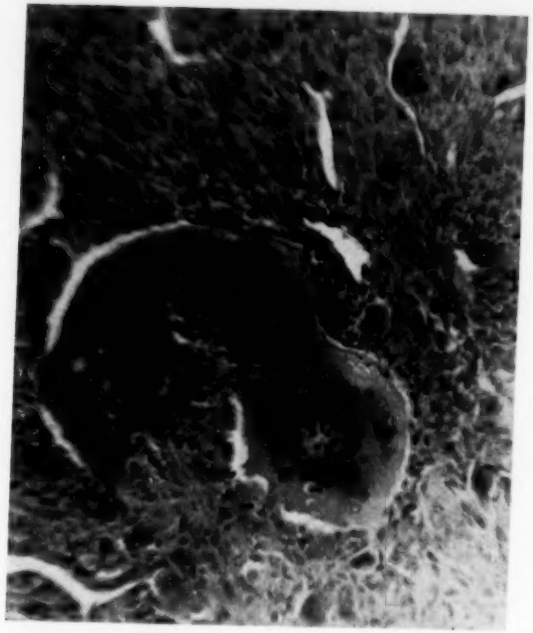

FIG. 2.—Photomicrograph of slide from growth 1 in tendon sheath, showing several giant cells. Note particularly the shape and size of the one in the centre of the field. Zeiss objective E.

FIG. 3.—Low power photomicrograph of small growth 2 in tendon sheath, enlarged about 8 diameters. Note capsule.

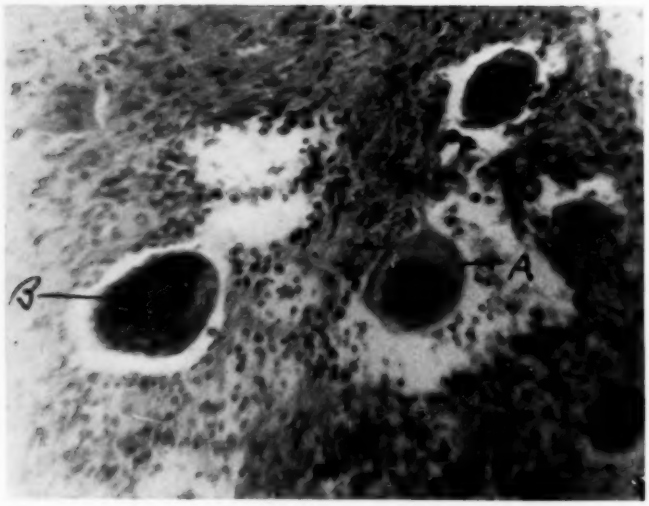

FIG. 4.—Photomicrograph of slide from growth 3 in tendon sheath. Observe the process on giant cell *A* and the dense mass of deeply staining nuclei on *B*. Zeiss objective E.

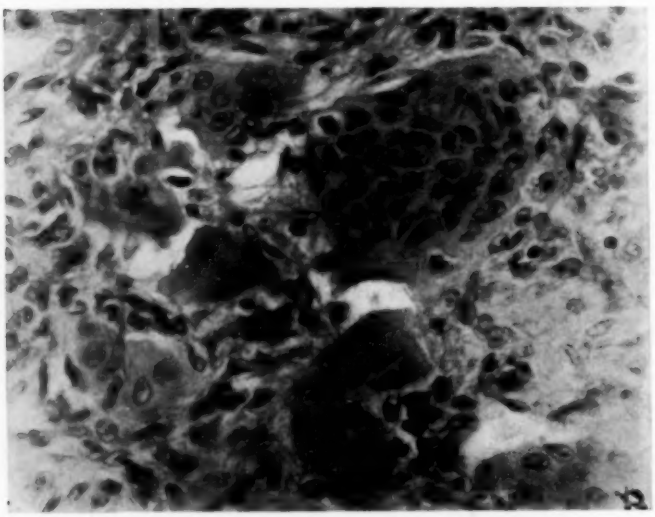

FIG. 5.—Photomicrograph of growth in bone. High power.

carbolic acid, the wound was sutured in two layers, and the foot was put up in plaster of Paris. The layer of bone on the medial aspect of the fibula was not disturbed; hence the mortise of the ankle-joint remained as before.

The contents of the tendon tumors were similar to the contents of the bone, except that they were yellowish brown in color. The largest one of the three was the proximal one.

Histology.—1. Growth in tendon, below the lateral malleolus. A well-defined capsule is present, except on one side. Running in from one section of the capsule is a small wedge of osteoid trabeculæ with its base at the capsule. In several places the growth is making its way through the capsule.

The growth itself consists of a delicate stroma of fibrous tissue with an abundance of spindle cells (fibroblasts) and many giant cells. The giant cells vary greatly in shape and in number of nuclei. Some of the nuclei stain fairly sharply, and have a smooth outline and a well defined nucleolus. Some stain poorly, and have a dentated outline. Many are dead, and appear as granular collections. Scattered through the growth are many endothelial leucocytes.

The giant cells are irregular in outline, without a limiting membrane, and are composed of hyaline or faintly granular material. They look as if they had arisen from the fusion of a number of endothelial leucocytes, with a subsequent degeneration of the cell body.

A few blood-vessels are present and many larger or smaller clefts containing blood pigment.

2. The small growth in the tendon sheath, posterior to the growth in the bone, differs from it in having a capsule more nearly complete. It contains also a few trabeculæ of osteoid tissue. Here and there one can see a large, clearly defined cell containing many small, round, deeply staining nuclei. It stands out in sharp contrast to the other giant cells. Its cytoplasm also stains more deeply.

3. The large growth situated just distal to No. 2 is similar to it. It also contains a few minute trabeculæ of osteoid tissue, and in places shows hemorrhage into the tissue of the growth itself.

4. Material removed from the bone tumor shows a delicate stroma of fibrous tissue, with masses of spindle cells and many giant cells similar to those described in the tendon growths, but not so large. A few thin-walled blood-vessels are present in the fibrous stroma, but the clefts described in No. 1 are not present. On the other hand, hemorrhage has been free into the mass. A few small osteoid trabeculæ are present, but no normal marrow tissue.

NOTE.—A letter from the patient on August 14, 1918, 29 months after the operation, says that she is in health, does her own housework, and suffers no pain or disability. There are no signs of the return of the growth.

The nature of these giant-cell growths has occasioned considerable discussion, and has not yet been definitely settled. Until comparatively recently, when found in bone, they were regarded as malignant, and were treated by amputation. Even as late as 1913, Stewart still maintained their malignancy. Barrie considers that they are due to hemorrhage in the marrow, and calls the disease hemorrhagic osteomyelitis. Adami, Mathews and others view them as myelomata. They occur preferably in young adults of from

twenty to forty years, and usually in the ends of the long bones or more rarely in the small bones. In other words, they are located preferably where lymphoid marrow is present. They show no tendency to involve the joint.

Almost all recent writers (with the exception of J. C. Stewart) say that when they are thoroughly removed, they do not recur, or, if they recur, that they may be removed again without any fear of metastasis. Bloodgood insists upon the importance of swabbing out the cavity in the bone with carbolic acid, but as to the actual necessity of this there is doubt, for no bacterial growth ever has been demonstrated in them. They replace practically all the bone and normal marrow tissue at the site of growth. The cortex over them becomes thin and expands, and, when of great thinness, crackles on pressure—"egg shell crackling." The growth does not often perforate the cortex and involve the surrounding tissues.

A history of trauma is often obtained, but whether the trauma is the cause of the disease or an effect, has not been determined.

The contents of the giant-cell tumor in bone are usually characteristic—friable, and yet with more or less cohesiveness, "currant jelly" in color, often with mottled areas of fibrous tissue. They can be scooped out easily.

No tendency to spontaneous cure has been noted, nor any tendency to secondary infection unless produced by unwise operative measures.

Giant-cell growths of tendon sheaths have also occasioned considerable discussion. Fleissig thinks they are granulomata. Others call them sarcomata. Generally they run more to a yellowish color than to red.

Histologically, giant-cell growths consist of a delicate stroma of connective tissue, with spindle cells and giant cells. Some writers, *e. g.,* Mallory, view these last as foreign-body giant cells, others (Adami, Mathews) as true myeloplaxes. In this case of mine they looked entirely unlike the typical myeloplax, but distinctly like the giant cell of a granuloma. In fact, many of them have no likeness to a cell, and are only called giant cells from custom. They would be described more properly as a collection of nuclei surrounded by an irregular mass of hyaline or faintly granular material. The appearance of the growth in this case is distinctly that of a granuloma.

BIBLIOGRAPHY

Stewart, J .C.: Surgery, Gynecology and Obstetrics, 1913, xvii, 30.
Bloodgood: Annals of Surgery, 1910, lii, 145, 388; 1912, lvi, 210.
Kramer: Archiv für klinische Chirurgie, 1902, lxvi, 793.
Kocher: Beiträge z. klinische Chirurgie, 1906, l, 145.
Barrie: Annals of Surgery, 1913, lvii, 244.
Fritsch: Beiträge z. klinische Chirurgie 1908, lx, 344.
Fleissig: Deutsche Zeitschrift f. Chirurgie, 1913, cxxii, 263.
Beekman: Annals of Surgery, 1916, lxii, 738.

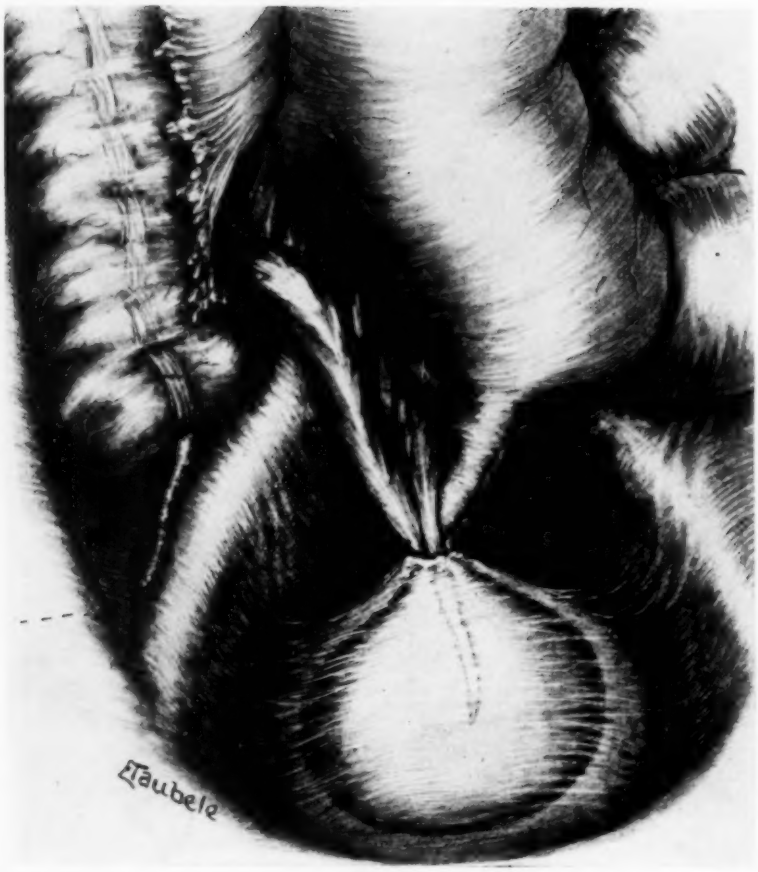

FIG. 1.—Intestinal obstruction produced by evagination of ileum into urinary bladder through a perforated vesical ulcer. Ileum partially withdrawn to disclose ulcer margin.

INTESTINAL OBSTRUCTION PRODUCED BY THE EVAGINATION OF ILEUM INTO THE URINARY BLADDER

By W. Howard Barber, M.D.
of New York

(From the Department of Surgery, New York University and Bellevue Hospital Medical College)

Strangulation of the terminal ileum caused by its passage into the urinary bladder is possibly unique. Adhesions and embryonal remains may give rise to obstruction of both the lumen and blood supply of the hollow viscera. Of the adhesions, those arising from previous operation, an inflamed appendix or tube are common. Among the embryonal remains are abnormal cords and membranes, intra-abdominal peritoneal pouches, and congenital herniæ. The end-ileum is occasionally intussuscepted. But the following case presents strangulation that depends neither upon scar tissue nor hernial openings and, although it grossly resembles intussusception, is far different from it.

S. M., nineteen years of age, first seen April 30, 1918. His symptoms were nausea and vomiting, no movement of the bowels in six days, sharp hypogastric pain, abdominal distention, tenderness and rigidity in right lower abdomen. His operative findings (same day) were acute dilation of the stomach and small intestine down to the distal ten inches of ileum, adjacent six inches of ileum tightly held within the urinary bladder, terminal four inches of ileum and whole of colon completely relaxed (the bladder was partially intussuscepted together with the intestinal loop so that it was at first impossible to be assured that the pathology was not a true enterovesical intussusception), punched-out ulcer, 1.5 cm. in diameter, in fundus of urinary bladder. There was a small amount of yellowish fluid, more resembling serum than urine, within the bladder and free in the peritoneal cavity. The bladder appeared normal without, and, barring congestion of the mucous lining, looked normal within. The technic was freeing of obstructed loop, closure and inversion of ulcer, closure of right rectus incision in layers. Findings at ileostomy performed after an interval of eighteen days confirmed the same dilated condition of the stomach and oral intestine above noted and described in accompanying drawing. Obstruction disappeared. Notwithstanding the fact that the stoma was located well down in the distal half of the small gut, inanition progressed and terminated fatally on the thirtieth day.

Note.—(1) Acute perforated ulcer of urinary bladder. (2) Strangulation of small bowel by evagination within the bladder. (3) Acute suppression of urine. (4) Acute dilation of stomach and oral small gut. (5) Inadequacy of the freeing of the obstructed loop and necessity of ileostomy.

SURGICAL CLOSURE OF WOUNDS*

By Georges Dehelly, M.D.
of Le Havre, France

The surgeon, considering the diverse methods which present themselves to his initiative in the treatment of war wounds, must give first consideration to the prevention, control or treatment of infection. The basis of all these methods is the surgical treatment, and since the beginning of the war, surgeons have given it first place. But how chaotic the theories were, how insufficient the surgical treatment applied by those who had the most absolute confidence in it!

I shall not speak about the treatment applied in the early days of the war. This treatment was based on the belief in the asepsis of war wounds, and the treatment recommended by the chiefs of military surgeons was expectant treatment.

Immediately after the battle of the Marne the deplorable results of this expectant attitude showed that war wounds were almost all infected, and that in order to avoid grave infectious complications it is necessary to open the wounds widely as quickly as possible, to remove foreign bodies and to drain the wounds. This treatment improved results considerably, suppressing, to a great extent, the serious infectious complications; but though considered sufficient by a majority of the surgeons, it did not suppress infection completely. Cicatrization of wounds, often even insignificant, was brought about in thousands of cases only after five, six or seven months of dressing.

Carrel and Dakin thought that something better might be obtained and that the rational application of a judiciously chosen antiseptic would permit sterilization of these infected wounds and shorten considerably the time of cicatrization.

Having charge of surgery in the hospital at Compeigne, annexed to the laboratories of the Rockefeller Institute, I was quickly able to demonstrate the possibilities of this sterilization, and after four months of research, in August, 1916, I attempted, with my collaborator, Dr. Joseph Dumas, the surgical closure of wounds treated after the principles developed by Carrel and Dakin. In October, 1915, we arrived at the conclusion that every wound treated by the Carrel-Dakin method within a short time after the injury, and containing no more than one bacterium per four or five microscopic fields, could be closed without drainage. And since that time 90 per cent. of all kinds of wounds treated in our hospital were closed before the twelfth day. Consequently, we were able to assert that if sterilization of a wound must be the first step of this treatment the surgical closure must be the second step, no less indispensable to maintain the disinfection and to avoid all ill effects of a spontaneous cicatrization.

A majority of the surgeons followed us in this path, and if all did not

---

* Read before the American Surgical Association, June 6, 1918.

seek sterilization by the Carrel method they were obliged to adopt a part of the technic, and the bacteriological examination of wounds, initiated by Carrel, remains the only solid basis of a rational treatment of wounds.

In 1916 Gaudier recommended that the first operation permitting the excision of the walls of the wound containing necrotic tissue and bacteria can be followed by primary suture if done within the first eight hours after the injury. The improvement in surgical treatment brought about by the complete mechanical cleansing is able alone in a certain number of cases to ensure sterilization, and suture can follow immediately upon the heels of this mechanical cleansing to ensure the maintenance of the sterilization. However, this primary suturing is sometimes followed by serious accidents, such as gaseous gangrene, diffuse phlegmon or streptococcemia.

The last report of Tuffier and Saquepee to the Surgical Inter-Allied Conference shows the necessity for finding a test giving the limit for primary suture.

The defect in the technic, claimed by Gaudier, is the impossibility for the surgeon to ascertain whether or not he is able to close the wound without accident after a surgical cleansing. This technic is still empirical and the necessity of including in it the bacteriological examination is shown by the number of researches published in this direction.

Duval, to avoid the grave failures of the primary suture, used to keep all the wounds open with an aseptic dressing and to delay the surgical closure until the results of the bacteriological examination were known. This procedure was based on the findings that 77 per cent. of wounds thoroughly operated within the sixth or seventh hour after the injury remain sterile under aseptic dressing. In fact, the other 23 per cent. are about the percentage of failures in primary closures. And following this technic, Duval escaped the serious complications from primary sutures.

Gross and Tissier, in March, 1917, claimed that the presence of streptococci must decide the reopening of a wound closed primarily. In other words, they think that serious complications will only arise from the closure of a wound containing streptococci. They did not say that it is impossible to suture a wound with streptococci, but that when a wound is sutured primarily, a bacteriological examination having been made at the same time, if streptococci develop in the culture it is necessary to remove all the sutures. There are several errors in this point of view:

1. The streptococcus is the most important cause of failure, but it is not always a cause of failure. There are examples of successful sutures of wounds containing streptococci reported in the work of Tuffier and Saquepee.

2. The streptococcus is not alone a cause of failure. The anaërobic bacteria and virulent staphylococci are often causes of infectious complications.

Levaditi, working with Depage at La Panne, studied the bacteriological evolution of wounds and formulated rules based on this evolution. Levaditi says that in the first period—during twenty-four or forty-eight hours—if the

bacteria are virulent they are growing fast. In this case it is impossible to close with any kind of bacteria. If the bacteria are not virulent it is possible to close, providing they are not streptococci or Welch bacilli.

In a second period if a wound is not closed after the first period of equilibrium between the organism and the bacteria the bacteria adapted in the wound can grow, the equilibrium being destroyed in their favor. This is the period of acute inflammation during which, progressively, the organism is increasing its means of spontaneous defense. In the third period these means of defense are stronger than the attacking power of the bacteria, the development of the bacteria is arrested, and their virulence diminishes progressively.

During the second period, or period of acute inflammation, it is impossible to suture a wound, but during the third period, or period of diminution of the virulence of the bacteria, Levaditi says that it is possible to close a wound even if the bacteria are numerous, provided they are not streptococci or gas bacilli.

To sum up the conclusions of Levaditi: There are three periods in the evolution of the bacteria in a wound:

1. In the first period we must resort to secondary suture early (within twenty-four or forty-eight hours after the injury) in the case of a wound which has been widely opened and treated by the Carrel-Dakin method, and which is known during the first hours to be sterile or but slightly infected by other bacteria than streptococci or gas bacilli.

2. In the second period we must apply the Carrel-Dakin treatment and await *la crise*.

3. In the third period "it is necessary to wait until the bacteriological chart reaches the zero point to close the wound, provided that these bacteria were attenuated and not streptococci."

But to apply these rules it is necessary to employ a bacteriological examination more complete than we did.

Levaditi says that the cultures are the best index of the quality and the virulence of the bacteria, employing at the same time smears to measure the quantity of germs.

The delayed secondary suture makes slower progress, because it is more difficult to be certain of the bacteriological condition of the wound in the granulating tissue. In this condition technic is still hesitating and the failures numerous. These failures are due to the granulating tissues which grow during the suppuration. Every granulating wound treated aseptically cicatrizes, retaining in the scar tissue numerous bacteria. These bacteria possessing attenuated virulence are, nevertheless, susceptible of renewed vigor, especially at the time of an operative traumatism, such as may be necessitated by a secondary closure. It is for this reason that it is essential to diminish the infection and to treat it as early as possible. If primary suture has not been accomplished, through impossibility or failure, it is necessary

to employ immediately an antiseptic method by means of which cicatrization may be accomplished without latent microbism.

It would be, indeed, a great mistake to accept as axiomatic that the primary closure must take the place of all the others. It is evident that where it is possible to practise it without danger to the patient it is of considerable benefit. But we must not forget that this procedure is possible only in certain periods of warfare: When the wounded are not very numerous—that is, if an attack is to be made on a short part of the front—it is possible to forecast the number of wounded and to provide the necessary surgeons. But as soon as the number of wounded increases, due to the extension of the front or change to open warfare, it is impossible to perform the complete operation close to the front line. It is then necessary to do only the minimum: only to open the wounds, only to do hemostasis and to send the wounded to the rear. Here we find again infected wounds at the acute period, and it is necessary to treat the infection before secondary closure. Thus one will see that the impossibility to complete the surgical operation at the front is not confined to times of retreat, but may happen even with an advance. During the battles in Flanders last fall the British were compelled to follow this rule. The wounded, hastily operated on at the front, reached the base hospital in suppurating condition. I was able to verify this fact at the base hospitals of Rouen, where the American units from St. Louis and Cleveland were working.

We must not be asleep with too great an optimism and believe that infection is overcome.

Great progress has been made since the simple opening and drainage of wounds to their complete excision and closure. But these primary and secondary closures are not always performed under the best conditions. We lack, even now, an effective test which will indicate, after an operation, whether the wound contains virulent or non-virulent bacteria, and whether or not we can safely close it.

TECHNIC. I will not burden you with a very detailed technic for the surgical closure of wounds. It is done without special precaution when it is done early. I wish only to call attention to some new facts. Whatever may be the procedure employed the following precautions must be observed:

1. The closure must be complete as much as possible. If the suture is not complete there is reinfection from the exterior generally from the skin.

2. The stitches should be without exaggerated traction. Tension of the stitches puts the skin in bad condition of defense against infection.

3. Under the cutaneous suture no cavity must be left in which secretions can accumulate. The secretions accumulated in the cavity constitute a very good medium for the culture of the bacteria. There is, however, a procedure which banishes complications when suture is not absolutely complete or if there is reason to fear a hematoma (the hemostasis having been difficult) or if there is any oozing whatever. This happens often in the secondary closure of stumps with resection of scar tissue and bone ends. In these

bacteria are virulent they are growing fast. In this case it is impossible to close with any kind of bacteria. If the bacteria are not virulent it is possible to close, providing they are not streptococci or Welch bacilli.

In a second period if a wound is not closed after the first period of equilibrium between the organism and the bacteria the bacteria adapted in the wound can grow, the equilibrium being destroyed in their favor. This is the period of acute inflammation during which, progressively, the organism is increasing its means of spontaneous defense. In the third period these means of defense are stronger than the attacking power of the bacteria, the development of the bacteria is arrested, and their virulence diminishes progressively.

During the second period, or period of acute inflammation, it is impossible to suture a wound, but during the third period, or period of diminution of the virulence of the bacteria, Levaditi says that it is possible to close a wound even if the bacteria are numerous, provided they are not streptococci or gas bacilli.

To sum up the conclusions of Levaditi: There are three periods in the evolution of the bacteria in a wound:

1. In the first period we must resort to secondary suture early (within twenty-four or forty-eight hours after the injury) in the case of a wound which has been widely opened and treated by the Carrel-Dakin method, and which is known during the first hours to be sterile or but slightly infected by other bacteria than streptococci or gas bacilli.

2. In the second period we must apply the Carrel-Dakin treatment and await *la crise.*

3. In the third period "it is necessary to wait until the bacteriological chart reaches the zero point to close the wound, provided that these bacteria were attenuated and not streptococci."

But to apply these rules it is necessary to employ a bacteriological examination more complete than we did.

Levaditi says that the cultures are the best index of the quality and the virulence of the bacteria, employing at the same time smears to measure the quantity of germs.

The delayed secondary suture makes slower progress, because it is more difficult to be certain of the bacteriological condition of the wound in the granulating tissue. In this condition technic is still hesitating and the failures numerous. These failures are due to the granulating tissues which grow during the suppuration. Every granulating wound treated aseptically cicatrizes, retaining in the scar tissue numerous bacteria. These bacteria possessing attenuated virulence are, nevertheless, susceptible of renewed vigor, especially at the time of an operative traumatism, such as may be necessitated by a secondary closure. It is for this reason that it is essential to diminish the infection and to treat it as early as possible. If primary suture has not been accomplished, through impossibility or failure, it is necessary

to employ immediately an antiseptic method by means of which cicatrization may be accomplished without latent microbism.

It would be, indeed, a great mistake to accept as axiomatic that the primary closure must take the place of all the others. It is evident that where it is possible to practise it without danger to the patient it is of considerable benefit. But we must not forget that this procedure is possible only in certain periods of warfare: When the wounded are not very numerous—that is, if an attack is to be made on a short part of the front—it is possible to forecast the number of wounded and to provide the necessary surgeons. But as soon as the number of wounded increases, due to the extension of the front or change to open warfare, it is impossible to perform the complete operation close to the front line. It is then necessary to do only the minimum: only to open the wounds, only to do hemostasis and to send the wounded to the rear. Here we find again infected wounds at the acute period, and it is necessary to treat the infection before secondary closure. Thus one will see that the impossibility to complete the surgical operation at the front is not confined to times of retreat, but may happen even with an advance. During the battles in Flanders last fall the British were compelled to follow this rule. The wounded, hastily operated on at the front, reached the base hospital in suppurating condition. I was able to verify this fact at the base hospitals of Rouen, where the American units from St. Louis and Cleveland were working.

We must not be asleep with too great an optimism and believe that infection is overcome.

Great progress has been made since the simple opening and drainage of wounds to their complete excision and closure. But these primary and secondary closures are not always performed under the best conditions. We lack, even now, an effective test which will indicate, after an operation, whether the wound contains virulent or non-virulent bacteria, and whether or not we can safely close it.

TECHNIC. I will not burden you with a very detailed technic for the surgical closure of wounds. It is done without special precaution when it is done early. I wish only to call attention to some new facts. Whatever may be the procedure employed the following precautions must be observed:

1. The closure must be complete as much as possible. If the suture is not complete there is reinfection from the exterior generally from the skin.

2. The stitches should be without exaggerated traction. Tension of the stitches puts the skin in bad condition of defense against infection.

3. Under the cutaneous suture no cavity must be left in which secretions can accumulate. The secretions accumulated in the cavity constitute a very good medium for the culture of the bacteria. There is, however, a procedure which banishes complications when suture is not absolutely complete or if there is reason to fear a hematoma (the hemostasis having been difficult) or if there is any oozing whatever. This happens often in the secondary closure of stumps with resection of scar tissue and bone ends. In these

cases cutaneous suture is made as complete as possible, but one or two instillation tubes are left under the skin to sterilize the subcutaneous cavity by the Carrel-Dakin method without the necessity of removing stitches, if there is some inflammation after the operation.

These diverse rules must be more strictly applied in the suture of old wounds made after a long period of suppuration. Indeed, the granulations contain bacteria (now attenuated but liable to be increased by the traumatism), and it is necessary to avoid the possibility of a new suppuration which would prevent success of the suture. Besides, these granulating tissues have made the walls of the cavity in the muscles rigid, and the suture of the skin will be insufficient to efface this cavity. Furthermore, the skin is extremely retracted and the surgeon is unable to close the wound completely without too great a tension of the stitches. We must then have recourse to a very simple procedure—namely, the corsetage of the wound for forty-eight hours before the operation.

This consists of the application on each side of the wound of adhesive plaster, along the edges of which, at intervals, are hooks. A rubber string laces this, thus bringing together the edges of the wound. Retraction of the skin is easily overcome, and in twenty-four to forty-eight hours the edges are in contact. The more or less intramuscular cavity is thus effaced, and it becomes possible to suture the skin without having to act on the granulating tissues wherein infection is most to be feared. To effect the suture it is sufficient to resect the epithelial line, to raise the edge of the skin 1 or 2 centimeters and to stitch after a precise joining of the edges.

Sometimes the granulations are so thick that it is better to curette them to diminish the thickness of the scar. In these cases I prefer to operate twice: (1) surgical resection of the scar, followed by sterilization with the Carrel-Dakin treatment; (2) closure, several days later, after sterilization.

I had to treat a great number of extensive streptococcic phlegmons in Rumania last winter, which phlegmons I was able to sterilize by the Carrel-Dakin method and to close through the medium of an elastic corsetage. These closures were made in one step in those cases which were under my care from the beginning—in two steps where the sterilization was begun after a long period of suppuration.

Another difficulty may be encountered by the presence of a bone cavity, in order to close which it is necessary to begin filling it before the closure. We employed several procedures to fill these cavities, using several kinds of paste or transplanted fat-grafts. A new procedure recommended by my associate, Doctor Guillot, seems better than the others. It consists of closing the cavity with a flap of skin to which is adherent and appendant a flap of subcutaneous fat, the fat filling up the cavity, which is covered by the skin, sutured at the edge of the wound.

There are, however, some cavities that we can close without filling. These are the joints and the pleural cavity. The articular cavity is made to be permanent and the pleural cavity will be quickly effaced by the spon-

taneous distention of the lungs. We had this winter considerable experience with streptococci empyema, and all the cases treated before the period of rigidity of the walls of the infected cavity were successfully closed.

I do not wish to prolong these details. I wish only to call attention to the fact that if we have made any progress in the treatmen of infected wounds it is because surgery has discarded empiricism, becoming more scientific through the acceptance of help from other sciences, such as biological chemistry, bacteriology and mathematics.

The time is past when the appearance of the wound and the temperature chart were sufficient indicators to the surgeon of the evolution of a wound. Something else is necessary. The bacteriological chart of Carrel and a complete bacteriological examination must enter into the practice. An antiseptic substance must no longer be judged by the color it imparts to the wound, but according to the real effect on the secretions on the dead or living tissues and on the germs which contaminate it.

It is just to say that this evolution of surgery has been guided by the work of Carrel and Dakin.

THE PHYSICAL FACTORS INFLUENCING INFECTION*

By Walton Martin, M.D.

Of New York, N. Y.

I have used the word physical with the idea of discussing the relative importance of certain mechanical features which influence the initial lodgment and the persistence of infection. I have not had in mind the consideration of the effects of physical forces, such as light, heat or electricity, on the growth of microörganisms within the tissues.

During the war the whole subject of infection has been studied under very special conditions. All the injuries by artillery projectiles and rifle and machine-gun bullets at close range are heavily infected, and, as we all know, this has been the usual type of injury in the warfare of the past three years.

If left to themselves or treated conservatively they regularly develop infection, often of a type and severity rarely seen in civil practice. The evolution of these lesions has been studied and methods of treatment suggested not only by surgeons whose work in civil life, in great industrial centres, has accustomed them to the treatment of infected wounds, but also by those trained in the technic of experimental laboratories, by pathologists and chemists. An intensive study has been made by these different groups and the whole subject considered from many fresh and stimulating points of view. But no essentially new surgical problems have been presented, attention has simply been turned from measures directed toward the prevention of the introduction of microörganisms after the wound is inflicted to means of combating infection already implanted. At the outbreak of the war the ruling idea was the avoidance of secondary infection.

It is common knowledge that pyogenic microbes are frequently introduced into the body without producing any pathological effect. They enter the tissues and are destroyed there by the activity of the body cells. We know that many accidental wounds are contaminated by pathogenic microorganisms and yet heal without evidence of infection. Operative wounds are frequently soiled by bacteria in performing gastro-enterostomy, intestinal resection or in the removal of an infected appendix, and yet heal by primary union. Infection is uncommon in gunshot injuries seen in civil practice made by bullets of low initial velocity. Eighty-five per cent. of the injuries from the pointed modern rifle bullets in the Japanese-Russian War healed without reaction according to von Oettingen.[1] In all these injuries bacteria are introduced into the wound but the relation between tissue vitality and microörganisms is such that infection does not occur. The wounds are contaminated but not infected—that is, there is no clinical evi-

* Read before the American Surgical Association, June 6, 1918.

dence of the group of reactional phenomena either local or general which we are accustomed to consider as furnishing evidence of infection. It has been shown experimentally that a few bacteria can be introduced without producing any effect, that larger doses cause local infection, whereas death regularly follows injection of very large numbers. It is well known that bacteria have not a fixed virulence, and that their toxic action can be exalted or attenuated by a number of causes, but aside from the dosage and virulence of the microbes, and the susceptibility of the individual inoculated, there are certain factors purely mechanical which play a most important part in determining whether or not the microörganisms gain foothold in the tissue and multiply there and control their progress when they have become established in the tissue. That is the gravity of infection is regulated by a number of mechanical conditions which are realized anatomically in certain wounds and not in others. These conditions are (1) pressure at the focus of infection, or point of initial lodgment; (2) foreign bodies; (3) devitalized and necrotic tissues; (4) dead spaces.

It is well known that an open wound is infected with difficulty, whereas irregular wounds, punctures or lacerations are prone to infection. Obviously the welling up of blood and the outflow of blood and lymph must wash away foreign material. The ordinary pathogenic bacteria are non-motile. When they are brought in contact with the wound surface they can only find lodgment there, like any other foreign body, through some mechanical factor; as long as there is free flow from every part of the surface of the wound they must be necessarily carried away. It is also evident that unfavorable conditions exist in the wounds open to light and air for the colonization of anaërobic organisms.

The question of the open wound and its relation to infection has been studied experimentally by Friedrich.[2] He amputated the tails of mice by a clean cut, then introduced the stumps into a virulent bouillon culture of anthrax and kept them there from five to thirty minutes. The animals all lived. In a second series he kept the wounded surfaces in the culture media for as long as three hours, then reamputated higher up. Three of these animals lived, in a fourth there was contamination during the reamputation and the animal died. All the control animals died after subcutaneous injection of the same culture in from thirty-four to forty hours. He concludes that even in susceptible animals highly virulent cultures of anthrax bacilli are unable to cause progressive infection if every possibility of creating local pressure and every mechanical adjuvant is removed.

The division of the different planes of tissue, skin, cellular tissue, aponeurosis and muscle, each with a different degree of elasticity and tensile strength, causes a shifting of planes one over the other, and this displacement of the layers is also brought about by any change from the position in which the wound is received. The deeper the wound, the nearer it approaches a puncture or perforation the more marked is the action, it reaches the maximum in gunshot injuries where certain parts of the track of the missile may

be completely shut off. Consequently the blood and lymph poured out from the severed tissues escapes only partially externally, a portion spreads out internally along the line of cleavage between the tissues. Foreign material introduced into the wound is then carried inward, not outward. The more irregular the wound surface, the greater the clefts and cevices, the less easily will bacteria be washed away by the lymph and blood. It must be remembered that even the surface of a clean-cut incised wound looks irregular and torn under the microscope, magnification of the blade of the sharpest knife shows a serrated edge and the severance of the body tissue by it inevitably causes irregularities large in relation to the size of the bacteria.

By friction organisms are readily forced into the wound surface. The rapidity with which they are thus absorbed is well shown by the experiments of Schimmelbusch.[3] He found anthrax bacilli in the viscera ten minutes after he had vigorously rubbed them into an incised wound in the tail of a mouse, nor did amputation at this time prevent a fatal outcome. However, the pressure of blood issuing from divided vessels is usually sufficient to keep the pathogenic bacteria from entering the blood stream, and under ordinary conditions they start to grow, make toxins, cause tissue necrosis, determine a lymph flow and exert a positive chemotaxis. A wall of leukocytes surrounds the focus of infection. However complex the causes of these phenomena may be, whatever relation they bear to osmotic pressure or to chemotaxis, whether the cellular wall about the focus may be looked on as a semipermeable membrane, whatever the relation of the crystalloids and colloidal substances at the centre of the focus, we certainly know there is created about a nidus of infection an accumulation of fluids under pressure, and whenever this pressure exists there are clinical evidences of inflammation and the relief of this tension by purely mechanical measures is regularly followed by subsidence of the manifestations of reaction to infection, and so delicate is this relation that the slightest increase in pressure is followed by a recrudescence of the symptoms. This is a surgical principle too well attested to discuss—it is the basis of all effort at wound drainage. It is the fundamental idea in the open treatment of wounds.

In wounds a mechanical barrier to infection is rapidly furnished by a wall of leukocytes arranged along the wound surface. At first, to be sure a delicate one and easily broken by trifling mechanical violence. Giani[4] showed this experimentally. He soaked filter paper in a virulent culture of anthrax, then laid the piece of paper gently on the surface of fresh wounds two, six, eight, ten and fourteen hours after they were inflicted. Even at two hours a third of the animals survived and in the ones in which infection occurred he was able to recognize, by slight signs of hemorrhage, a break in the protecting wall of leukocytes. At fourteen hours all recovered.

It has also been shown that even if bacteria become established and start to grow on an open wound surface, and there is no mechanical violence or pressure from without, their growth remains on the surface for a number of hours and can readily and certainly be removed by purely mechanical means.

Friedrich[8] contaminated fresh wounds in mice with garden earth and street dust, then excised by a clean cut the surface tissue of the wound to the depth of the 2 mm., using a sharp knife and taking care not to touch the fresh wound with instruments that had come in contact with the contaminated surface. Animals in which the excision was done within six hours, all recovered. Those in which the excision was done after ten hours, all died. Those done at seven hours showed marked signs of local infection, but finally recovered. After excision the wounds were left open. The prevailing organism was the bacillus of malignant edema. Controls died without exception in a short period of a type of gas gangrene.

Local pressure then has been proved experimentally as well as practically to be a physical factor of great importance both in the initial lodgment and in the persistence of pathogenic bacteria in the tissues.

Undoubtedly foreign bodies introduced into the tissues act unfavorably on the vitality of the surrounding cells. They act as both mechanical and chemical irritants. They seem to make it difficult for the bactericidal forces of the body to kill the microörganisms implanted with them. Gaffsky,[9] however, concludes an article on the relation of foreign bodies to infection with the statement that they exert, as a rule, very little influence. He can hardly mean on the persistence of infection.

But the main significance of the foreign body is as a vehicle or conveyer of infection; it is a most effective means of carrying microörganisms into the tissues and lodging them there. Particles of earth, splinters of wood, fragments of glass, soiled and contaminated, are frequently embedded in the tissue. In gunshot injuries fibres and particles of soiled clothing, surface dirt, all manner of small objects are violently forced into the tissues, each with its modicum of infection. These bodies are more or less anchored in the tissues—the flow of lymph and blood is incapable of carrying them out.

How widespread is the fixation of infected foreign bodies in the tissues in gunshot injuries was pointed out by Müller[18] and Koller.[19] They showed by experiments in wounds by high velocity modern rifle bullets that fibres of clothing were forced into the sound tissue surrounding the track of the missile, and it was possible to disinfect the track with caustics or the actual cautery.

In June, 1915, Policard and Phélip[7] made an interesting report on the histological and bacteriological findings about infected foreign bodies. They had studied and analyzed the biological processes of attack and defence about fragments of clothing introduced into the deeper tissues by shell fragments at periods varying from an hour and a half to three days after the wounds were inflicted, and the number examined had been sufficient to enable them to follow the evolution of the lesions. The blood from severed vessels is poured out about the foreign bodies at the time of the injury, it rapidly coagulates, obeying the well-known physiological law. This coagulation is often so rapid that the centre of the wad is soaked with clear serum not impregnated with fibrin. Each fibre is glued in coagulum, and a sheath of

coagulated blood is formed about each foreign body; in this enveloping mass the bacteria brought in on foreign-body fragments begin to germinate and the tissues about them here first show signs of reaction. This reaction appears from the fifth to the ninth hour approximately. From the ninth to the twelfth hour one begins to recognize the appearance of microörganisms having the characteristics of the Bacillus capsulatus aërogenes. From the twelfth hour three related phenomena appear and progress simultaneously.

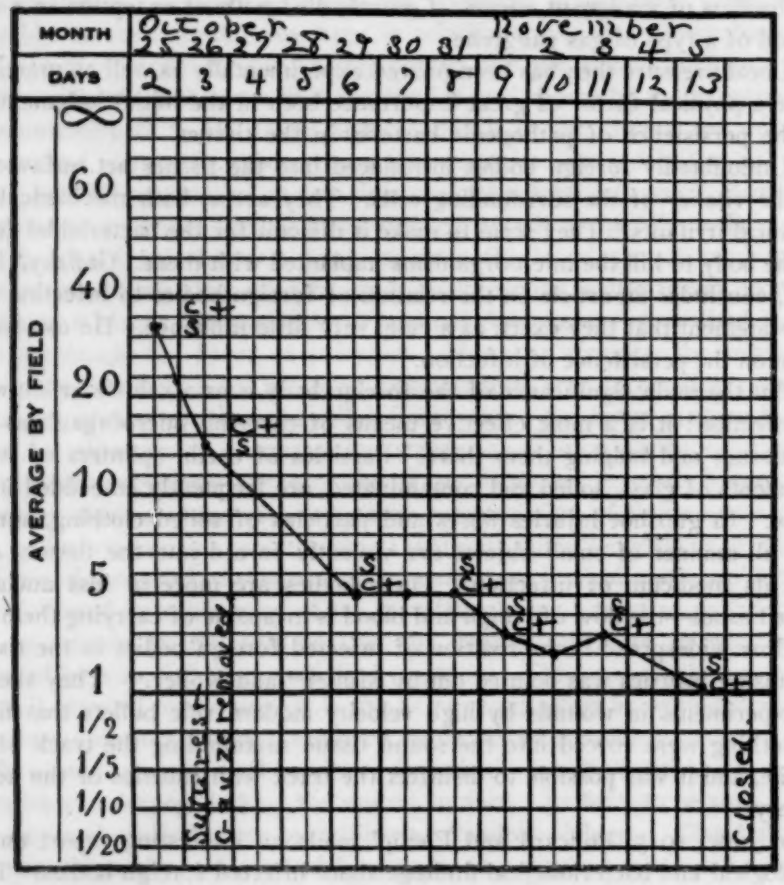

FIG. 1.—Dog. Infected foreign body removed. Wound closed in nine days.

The bacilli multiply, at first about the foreign bodies; they radiate more and more from these as centres of infection. Second, there is an afflux of polynuclear leukocytes. Third, the leukocytes are transformed under the action of bacterial toxin into pus cells. These phenomena at first progress slowly, then with ever-increasing rapidity.

If infection is established about a foreign body it has an extraordinary tendency to persist, and the removal of the foreign body causes this persist-

ent infection to cease. A sinus of months' standing rapidly closes as soon as the foreign body is extracted.

Miss Clarke, at the experimental laboratory of the College of Physicians and Surgeons, has kindly prepared for me a chart which illustrates in a graphic manner the fall in the number of bacteria after the removal of the foreign bodies. These foreign bodies are swarming with millions of organisms; when they are removed the body finds little difficulty in overpowering those that are left.

Foreign bodies then are most important factors in implanting infection, and in causing it to persist in the tissues.

After every injury there is a phase of cellular shock; there is a period of time following the injury when there is a paralysis of all cellular activity. It bears a direct proportion to the degree of the initial violence. The defensive power of the cells, their capacity for resistance, are held in abeyance during a varying period. The vitality of the cells is interfered with in some subtle fashion. After an incised wound this period is of short duration. After the violence exerted by hurling into the tissue a jagged fragment of shell casing it is prolonged for several hours. Poincard and Phélip found that wounds examined three or four hours after they were inflicted had the same appearance as those examined a half-hour after the injury. The phenomena of reaction were not only slow in appearing but always of slight intensity. A lowering of cellular vitality and its effect on lessening tissue resistance has been experimentally demonstrated by Roger and Josué.[8] They ligated the femoral or iliac artery in ten rabbits, then inoculated their legs with various pyogenic organisms. The controls all showed a small well-circumscribed abscess. On the other hand, in the animals where the arteries were ligated, there was extensive swelling of the entire leg and at autopsy all the evidences were found of a diffuse spreading infection.

In every injury there is not only interference with the vitality of cells, but there is cellular death. Here again the amount of necrosis has a direct relation to mechanical violence, and has an important relation to the initial lodgment of bacteria and to their persistence in the tissue. Linser[9] studied the influence of mechanical damage to the tissues at the point of initial lodgment in rabbits. He used staphylococci, streptococci and tetanus spores. He laid the muscle bundles of the abductor bare, then covered them with moist compresses. These animals were used as controls. In a second series of animals portions of the muscle were tied off, or allowed to dry by long exposure to the air or violently crushed. In the controls infection did not take place. In the second series a progressive and fatal infection resulted.

Certain organisms, like the tetanus bacillus and the group of anaërobic bacilli, which produce gas gangrene, are, in a measure, saprophytes; that is, they do not gain foothold in the tissue and multiply there unless there is a certain amount of necrotic tissue. Thus aside from the fact that most microörganisms find a favorable medium in necrotic tissue, a group of bacteria are only pathogenic when this medium is present. Moreover, some of

these, like the bacillus aërogenes capsulatus, seem to need a special form of necrotic tissue; they only flourish on dead muscle.

That the mechanical removal of all necrotic tissue, especially all dead muscle tissue from a contaminated wound, prevents gas gangrene has been definitely shown, and still more interesting is the fact that the disease can be arrested when established by the resection of the muscle or the group of muscles involved up to a point where the color and contractability of the muscle are normal and the blood supply good. Frankau, Drummond and Neligen[10] reported a year ago a number of cases treated successfully by this method.

In every wound the necrotic tissue must eventually be disintegrated and eliminated before healing can occur, so that the excision of the necrotic tissue along the track of the missile is only the removal mechanically of material which would eventually slough. The limitation of this removal to 2 mm., as given by certain writers, is obviously misleading. The rule given by Sencert[11] or H. M. W. Gray[12, 13] to cut away the tissue until there is a fresh bleeding surface seems to be generally accepted, for the amount of tissue damage bears a relation to violence inflicted. In an injury from a projectile it must depend upon the mass and velocity of the missile.

The elimination of the necrotic tissue from a wound is brought about to a very limited extent by autolysis. It is accomplished by the energetic proteolytic enzymes furnished by living leukocytes and set free by their destruction. In an infected wound the bacterial enzymes play a most important part in this elimination, but the products of their activity are proteoses, ptomaines and a row of decomposition products harmful locally and when absorbed. A morsel of necrotic tissue in an infected wound contains thousands of organisms and it is these nests of bacteria which are so frequently responsible for persistent infection. When they are cast off or removed the wound immediately heals. If one were to count the number of bacteria and chart them from an ordinary boil, I feel sure that there would be a most astounding fall with the elimination of the slough or necrotic core and the base line of one or two to a field would be reached six or nine days afterward. The different tissues have a varying degree of resistance to dissolution: connective tissue, blood plasma, lymph and muscle are rapidly destroyed, aponeurotic tissue and tendons are still less so, and bone is most resistant. Dead bone separated from the living tissue, swarming with bacteria as a focus of infection, may remain for years in the tissue.

Kenneth Taylor[14] has given the bacteriological findings in sequestra. He always found them infiltrated with bacteria. When the sequestrum is removed there is rapid healing, the closure of a long standing sinus.

Tissue necrosis, then, furnishes a suitable culture medium for bacteria, permitting them to flourish and multiply in the tissues. Devitalization of cells makes them react slowly. Foci surrounded by devitalized tissue are poorly defended.

In accidental wounds due to the different contractability of the tissue

planes and their displacement there is a tendency toward imperfect approximation of the walls of a wound. Dead spaces are readily formed. Even in operative wounds, if the entire area about the incision is removed and examined after what appears to be most painstaking apposition these spaces are frequently seen. If hemostasis has been exact they are filled with lymph. In bleeding wounds they rapidly fill with blood. In irregular lacerated wounds they are much larger and form stagnant pools of fluid in the tissues. Now although freshly shed blood and lymph are bactericidal this property is rapidly lost. Blood furnishes an excellent medium for bacteria. Dorst[18] has studied this disposition of hematoma to infection, he found that it was increased about forty-fold for the staphylococcus.

Long-continued infection, with imperfect drainage, together with rigid and unyielding scar tissue, frequently causes uncollapsible spaces, which do not disappear when the fluid within is evacuated. Whenever the exudate is removed there is a contraction to a slight extent of the cavity and a tendency to the closure of the orifice on the surface. Then again the fluid collects, the process repeating itself indefinitely until, by some mechanical means, the unyielding wall is obliterated. Such cavities are seen in chronic osteomyelitis. The most striking example is furnished after the imperfect drainage of the pleural cavity. By simply creating different anatomical conditions, by destroying by surgical operation the infected dead space either by removal of the outer wall, or the unyielding cicatrix holding down the elastic pulmonary tissue, the long-standing infection is arrested, and the old sinus closed.

Dead spaces furnish favorable conditions for the growth and persistence of bacteria in the tissues.

I have presented this paper with a certain diffidence. The reference to principles so generally recognized and so long known seems banal. I imagine the relief afforded and the prompt healing that follows the extraction of a splinter of wood or a sharp piece of flint from a festering wound must have attracted the attention of men of the Stone Age. If we could examine the rolls of papyrus from the great library at Alexandria, how many references might we not find to foreign bodies, imprisoned discharges, separation of slough and persistent fistulæ. "Recent ulcers (infected wounds) will be least exposed to inflammation if the matter is not prevented from escaping at the mouth of the sore," wrote Hippocrates, and Celsus in his chapter on extraction of foreign bodies writes, "A third kind of weapon which requires sometimes to be pulled out is a leaden bullet, or stone or some such thing. In all these cases the wound must be enlarged and what is within must be extracted." This is said to be the first mention of leaden bullets, there is no record of the nature of the weapon used for hurling them into the tissues.

I have referred to these principles, however, endeavoring to place a juster emphasis than is sometimes done on the various factors entering into the treatment of infection. All treatment is dependent on these principles, they are fundamental. No one believes, as far as I know, that one can

disinfect with a chemical only a wound from an artillery projectile. Yet by the application of these principles the excision of all necrotic tissue, the removal of all foreign bodies, apposition so carefully made that there are no dead spaces, the avoidance of tissue tension by exact hemostasis, these grossly contaminated lacerated wounds are converted to clean incised wounds, and many of them may be closed by suture successfully.

In the Surgical Conference of the Allies[15] last November it was said that the disinfection of the wound had passed from the domain of the chemist to the domain of the surgeon; primary suture had taken the place of secondary suture and had become the method of choice. General Bowlby,[16] in March of this year, pointed out that these principles were first recognized as advantageous for the knee-joint; then for head, lung and abdomen; and finally for the extremities.

If the infection is well established when the wound comes under treatment, here again these are the guiding principles; the foreign bodies must be removed, necrotic tissue excised, sequestra extracted, every pocket and irregularity laid open to establish drainage. After this is done and the wound flushed by an antiseptic of a certain concentration, for a certain time, and if the bacteria still persist in spite of the treatment, Carrel[17] writes they indicate the presence in "the deeper parts of the wound of foreign matter, such as shreds of clothing, fragments of projectile, splinters of bone or morsels of necrosed tissue." In other words, if at the original mechanical operation there has been a failure to carry out these fundamental principles the antiseptic most rigorously applied is unable to overcome these unfavorable physical factors.

Is a young surgeon about to go to France to treat infected war wounds likely to appreciate the relative importance of the excision of the necrotic muscular tissue about the track of the missile, if he reads that the first stage of treatment consists in mechanically preparing the wound for the penetration of the antiseptic? Is he more likely to have a just idea of the treatment of infected wounds if he reads two hundred pages on the application of the antiseptic and five or ten lines on these fundamental principles? Is there not danger of converting certain of the admirable technical methods into a ritual, and is not the stress on the unessential one of the predominant characteristics of ritual? I am far from depreciating the application of antiseptics, the rough bacteriological control of infected surfaces, the scrupulous cleansing of the margin of the wound, the avoidance of injury to the granulating surface, the study of the rate of healings by the interesting indices of cicatrization of du Nouy, and the importance of avoiding secondary infection.

But the essential factors, both in the initial lodgment of bacteria and their persistence in the tissue, are the relief of tissue tension and pressure from without; the mechanical elimination of necrotic and devitalized tissue; the removal of foreign bodies; the avoidance of stagnant fluids in dead spaces and the obliteration of uncollapsible cavities. The enormous experience

in the treatment of infected wounds gained in this great war has proved it without question.

BIBLIOGRAPHY

[1] von Oettingen, W.: Leitfaden der Praktischen Kriegschir, 1912, p. 72.
[2] Friedrich, P. L.: Arch. f. kln. Chir., 1899, lix, 481.
[3] Schimmelbusch: Fortschr. d. Med., 1895.
[4] Giani: Centralbl. f. Bakteriol., 1905, xl.
[5] Friedrich, P. L.: Venhandl. d. deutsch. Gesells. f. Chir., 1898, xxviii, 64.
[6] Gaffsky: Gedenkschr. f. R. v. Leuthold, 1906, i, 221.
[7] Policard et Phélip: Compt. rend. de l'acad., 1915, clx, 15.
[8] Roger et Josué: Cong. français de méd. de Bordeaux, 1895.
[9] Linser: Ztschr. f. Chir., li.
[10] Frankau, Drummond and Neligen: British Med. Jour., June, 1917, 729.
[11] Sencert, L.: Bull. et mém. Soc. de chir. de Paris, 1916, xiii, 1918.
[12] Gray, H. M. W.: British Med. Jour., August, 1915, 319.
[13] Gray, H. M. W.: British Med. Jour., March, 1918, 369.
[14] Taylor, Kenneth: Annals of Surgery, 1917, lxvi, 522.
[15] Dorst: Centralbl. f. Bakteriol., xx.
[16] Bowlby: British Med. Jour., March 23, 1918.
[17] Carrel: Infected Wounds, 1917, p. 171.
[18] Müller: Deutsch. Ztschr. f. Chir., 1897, xlvii, 199.
[19] Koller: Deutsch. Ztschr. f. Chir., 1897, xlvii, 211.

BOOK REVIEWS

SURGICAL TREATMENT. A Practical Treatise on the Therapy of Surgical Diseases for the General Practitioner and Students of Surgery. By JAMES PETER WARBASSE, M.D. Volume I, pages 947. Philadelphia: W. B. Saunders Co., 1918.

The rapidly enlarging demands of Surgery find an excellent demonstration in this portly volume of nearly one thousand pages, and with 699 illustrations. The volume is the first one of a series of three, all of which are to be devoted to surgical treatment alone. The author says that his object is to place in the hands of the surgeon the means for rendering help in every surgical condition under all circumstances, his aim being to make this information easily accessible and its application practical. He has laid us all under obligations by bringing out a book so full and elaborate, in which he has indicated his judgment as to the value of the infinite number of surgical procedures which the last thirty years has crowded upon the attention of the surgical world.

The illustrations, which are very numerous, are of the kind which really illustrate, not merely embellish. Take the series of cuts which illustrate the subject of lumbar puncture, pages 156 to 159, or the treatment of infected wounds, pages 238 to 246, and one will appreciate the value of good illustrations.

The book naturally begins with a statement of the general principles of surgical treatment and a discussion of surgical materials. Then after a chapter on anæsthesia, he proceeds to the consideration of wounds and their complications, and then proceeds to the general body tissues.

In the chapter devoted to the blood and blood-vessels, a full consideration of the various methods of transfusion is given. At the close of the discussion he records his personal opinion that the most simple, useful and effective method of transfusion is the citrate method.

A brief chapter devoted to the lymphatic system precedes those upon the diseases of bones which in their various phases, including fractures and dislocations, comprise a very considerable portion of this volume.

In the remainder of the volume the muscles, the skin and the nerves receive attention. A full index closes the volume.

The author's style is clear, his descriptions are exact and brief, his judgments are in general to be relied upon, and disclose the results of a naturally critical, judicial temperament brought to bear upon surgical problems, to the study of which large opportunity and long experience add weight to the final judgment.

THE SURGERY OF ORAL DISEASES AND MALFORMATIONS. Their Diagnosis and Treatment. By GEORGE VAN INGEN BROWN, D.D.S., M.D. Third edition, octavo, pages 734. Philadelphia: Lea & Febiger, 1918.

The rapidly succeeding editions of this book indicate the value which has been placed upon it by the colleagues of the author.

The general surgeon will be especially interested to see how a large number of the conditions which he has been in the habit of considering as belonging to his domain appear when approached from the viewpoint of the man whose primary training was that of a dentist.

Thus, in the chapter devoted to diseases of the nervous system affecting the buccal region, a very full and satisfactory consideration of trigeminal neuralgia is given. With regard to the pathology of this terrific and inveterate affection the paragraph devoted to the relation of the teeth to a certain proportion of cases given by the author is interesting. He says: "The pathological alterations which might be accepted as being distinctively representative of neuralgia of the fifth nerve are indefinite. Certain changes in Gasserian ganglia which have been removed have been demonstrated by Cushing, Spiller, and others, but, while it is recognized that trigeminal neuralgia may be due to central causes such as disease of the pons, hemorrhage, softening, multiple sclerosis, tumor, or abscess, through which the Gasserian ganglion or the fifth nerve may become involved, it is also caused by peripheral irritation, and in these cases pathological manifestations might be confined to affected branches of the nerve, and the Gasserian ganglion would probably not give any indication of pathological structural alteration. Certain changes, however, which take place in the pulps of otherwise normal teeth, in these cases lend color to the belief that there is always structural alteration in the nerve or its affected branches in greater or less degree, and that in the course of time, with progress of the disease, other more remote portions of the nerve undergo similar degenerative changes. Gordon believes that peripheral nerve degeneration is constantly present, and that this degeneration assumes the form of a neuritis which secondarily involves the Gasserian ganglion."

The dental aspect of trigeminal neuralgia naturally receives more full consideration than will be found in any general surgical treatise.

A novel idea to most surgeons will be the relation of what the dentists call tooth grinding to the development of affections of the branches of the trigeminal nerve. True, the author shows that cause and effect are so closely interwoven that it is practically impossible to differentiate between the two with sufficient certainty and exactness to warrant definite distinction. The author is of the opinion, however, that given any local or general excitant which may give rise to the habit of grinding or clinching the teeth at night, we have at once a factor capable of exercising most potent influences in the production of pain in the head. These he describes as follows:—

"The continued activity of the muscles of the jaws prevents perfect rest and is fatiguing in much the same sense as eye strain, with this difference,

however, that the ocular muscles are only active when the eyes are in use, whereas the activity of the jaw muscles, when the habit is fully formed, continues both day and night.

"The continued overuse of the teeth in this way gives rise to certain changes in the pericementum, the vessels and the nerves surrounding the apical ends of the roots of the teeth involved and the cementum of their roots. This may be in the nature of a chronic pericemental hyperæmia. This congestion can and does cause pressure upon the nerve filaments as they pass from the end of the root of the tooth to join the main branch of the nerve, which in neurotic individuals is amply sufficient to set in motion very serious painful conditions. Perhaps the most serious of all pathological changes that take place in the structures surrounding the roots of the teeth, as a result of this tooth-grinding habit, is the tendency of the roots of such teeth to be ankylosed. With the disappearance of the pericementum in the process of the development of the ankylosis, there results constriction of the little nerve fibres which during the periods of the attack are capable of giving rise to the most excruciating exacerbations of pain."

In the matter of surgical methods of treatment in trigeminal neuralgia, the Hartley-Krause and the Cushing methods for removing the Gasserian ganglion are described in full. Avulsion of the sensory root only (Spiller's operation) is not mentioned. Frazier claims for avulsion the following advantages: It is easier of execution than any other; it subjects adjacent structures to no risk and it is attended with a smaller percentage of corneal complications with a lower mortality.

Diseases of the maxillary sinus and diseases of the tongue each have a chapter. Malformations of the lips and of the palate naturally receive full consideration and abundant illustration. Tumors of the jaws, resections and fractures, and affections of the temporomandibular articulation are very satisfactorily considered.

The book is concluded by a chapter devoted to the treatment of gunshot wounds and fractures of the face and jaws under war conditions. As a whole, the book is an excellent presentation of the field of surgery which it undertakes to cover.

THE SPLEEN AND ANÆMIA. Experimental and Clinical Studies. By RICHARD MILLS PEARCE, M.D., ScD., with the assistance of EDWARD BELL KRUMHAAR, M.D., Ph.D., and CHARLES HARRISON FRAZIER, M.D., Sc.D. Octavo, pages 419. Philadelphia: J. B. Lippincott Company.

This book is in three parts: the first part, which is devoted to experimental and laboratory work, is by the senior author, Doctor Pearce. These chapters record the result of studies carried out in the Department of Research Medicine of the University of Pennsylvania. The second part is devoted to clinical observations by Doctor Krumbhaar and contains clinical studies of the splenomegalies and their resultant anæmias, and also the

results of splenectomies. A final chapter by Doctor Frazier is devoted to the surgical treatment of lesions of the spleen.

The laboratory experiments were performed upon dogs. The most important changes after splenectomy performed upon a normal animal are found to be (1) a varying degree of anæmia; (2) increased resistance of the erythrocytes; and (3) lessened tendency to jaundice when hæmolytic agents are administered. Less frequent results which follow the procedure are (4) destruction of erythrocytes by the endothelial cells of the lymph-nodes and the liver, and (5) transformation of the marrow of the long bones from a yellow to a red marrow. In many instances, the anæmia develops almost immediately and progresses gradually until about the end of the first month, when it reaches its point of greatest severity. The return to normal then begins and a blood condition similar to that before splenectomy is reached after two and a half to three months.

The changes following splenectomy in man, however, for the relief of diseased conditions is an entirely different matter. The removal of the spleen is always done in the presence of a more or less profound anæmia. The changes following this operation are not those resulting from the removal of a normally functioning organ, but those resulting from the removal of a source of hæmolytic or other toxic activity for which the altered physiology of the spleen is responsible. It is at this point that the clinical observations of Doctor Krumhaar come in, by whom the various forms of splenomegaly, Gaucher's disease, Banti's disease and von Jaksch's disease, hæmolytic jaundice and pernicious anæmia are in turn considered. The methods of study described form a valuable index to the possibilities of the clinical laboratory.

With regard to therapeutic measures in the anæmias of splenic origin, there are two that stand out as the chief, almost the only, sources of hope, namely, blood transfusion and splenectomy. While it remains undeniable that in a very large proportion of cases no permanent benefit results from repeated transfusions, nevertheless the evident benefit which has followed it in some cases occurs sufficiently often to constitute an indication for its use as a matter of routine in all such cases, especially since simple methods of technic have removed from the procedure of blood transfusion much of the dangers and difficulties formerly attending it. Transfusion is presented as the main hope in cases of pernicious anæmia:—First, previous to operation in order to get the patient in the best condition possible for the removal of the spleen, and after operation to increase and render permanent its effects.

As to the value of splenectomy, proper and careful study of the results which have been reported and collected from various sources show that there has been a real curative action in a limited number of cases, although the number is not sufficient to create much operative enthusiasm. Thus, as to the results of splenectomy in pernicious anæmia, the conclusion is that, although a few have continued in good condition for more than two years after operation, in no case can it be said that a cure has been effected,

for the blood of these individuals continues to show many of the characteristic signs of pernicious anæmia. It is true that many individuals show improvement shortly after operation, but of these a very large number fail to maintain this improvement and die in relapse or from intercurrent disease. Nevertheless, the temporary improvement that does follow splenectomy in the majority of cases and the long continued improvement that follows in the minority suffice to make splenectomy not only a justifiable operation, but in many cases an advisable one. It is a point of wisdom, however, that in no case can a cure be promised and in any case the operation should only be undertaken under the most favorable conditions. Experience has shown that the best results are obtained if the operation is preceded by one or more transfusions and those patients who relapse after operation may still be greatly helped by transfusion.

With regard to Banti's disease and the hæmolytic jaundices, splenectomy should certainly be given careful consideration, for in many cases the results have been so excellent as practically to have amounted to a cure.

The chapter by Doctor Frazier upon the operative technic is illustrated by a series of unusually fine plates.

The book as a whole forms an interesting example of the collaborative work of modern medicine and surgery.

BLOOD TRANSFUSION, HEMORRHAGE AND THE ANÆMIAS. By BERTRAM M. BERNHEIM, A.B., M.D., Instructor in Clinical Surgery, The Johns Hopkins University. Octavo, pages 259. Philadelphia and London: J. B. Lippincott Company, 1917.

The interest of Doctor Bernheim in the surgery of the vascular system is well known. The present volume is the further development of his chapter on blood transfusion in his book on the "Surgery of the Vascular System," already published. The rapid development of the field occupied by blood transfusion during the past few years is exemplified by the enlargement of the author's chapter into this interesting and valuable book, although the extensive use of blood transfusion as a part of the methods of the military surgeon in the treatment of the wounded in war had not entered into the conception of the author when he sent his book to the press only a year ago.

Every surgeon is interested in the extensive literature on the subject which the past year has accumulated. For this reference should be made to the literature given by Doctor Alexander Primrose at the close of his article on the "Transfusion of Blood in War," published in the August issue of the ANNALS OF SURGERY.

The author is quite justified, however, in the historical note with which he prefaces his book. It is as follows:

"The procedure of blood transfusion has evolved in successive stages from an undertaking of the most difficult and dangerous character, resorted to upon the rarest occasions, to a procedure of such simple and harmless character that it is utilized throughout the civilized world many, many times

each day. Hundreds of people have been saved from premature death from hemorrhage, and the number of conditions in which it is utilized for therapeutic benefit is constantly increasing. Still, we are only on the threshold of knowledge concerning the fundamental character of the procedure, and the uses to which it will eventually be put."

The indications for transfusion are clearly outlined. In the list given in addition to actual hemorrhage, there are included such hemorrhagic conditions as purpura hæmorrhagica, hæmophilia, and pernicious anæmia, leukæmia, for various infections, and for certain intoxications and poisonings. The list is concluded by simple anæmia from any cause.

The dangers of transfusions, particularly those due to hæmolysis and agglutination, are fully considered and the questions which must be answered in the selection of a donor for transfusion. An appendix is devoted to the tests by which one may determine the propriety of the use of any particular specimen of blood to be infused into a particular recipient.

After a full discussion of various methods of transfusion, one is interested in the final conclusion of the author, which is that "no method and no instrument is comparable in facility and elasticity to the citrate method of transfusion. Of late," he says, "I have used this method in preference to all others and venture to predict that within a few years all our cunningly devised instruments for transfusion will be of interest merely as curiosities." He says further that, "so far as can be determined, there seems to be little difference between the therapeutic action of whole blood and citrated blood." He says that "by repeated clinical trial he has proved that its use in all forms of bleeding is attended with the same happy results as is that of whole untreated blood." This conclusion, however, is qualified by the statement that a post-transfusion reaction, as manifested by a chill or fever, follows the citrate transfusion far more frequently than one with whole blood, and in cases where the donor's and recipient's blood match perfectly by every known test. Violent chill and fever up to 103 degrees, or 105 degrees, is to be expected about twenty minutes after transfusion in about one out of every three or four cases, and minor grades of the same reaction occur even more frequently. This, in his opinion, however, is of no consequence so far as the ultimate result is concerned, since it is unaccompanied by any blood destruction.

In the application of the sodium citrate method, the blood of the donor is received into a sterile graduated glass containing 25 c.c. of a 2 per cent. sterile solution of sodium citrate. While the blood is running into the receptacle, it is well mixed with the citrate solution by means of a glass rod. After 250 c.c. of blood have been taken, another 25 c.c. of the citrate solution are added. If more than 500 c.c. of blood are to be taken, a second glass container is provided, equipped in exactly the same manner. The author has not found it necessary to immerse the blood containing jar in hot water. The jar may be taken directly to the side of the recipient wherever he may be. A vein of the recipient has already been exposed and a cannula fastened into

it to which is attached a small rubber tube leading to a suitable funnel or flask, the tubing being filled with saline solution until the blood is poured into the funnel above. In order to prevent sudden overloading of the circulation, it is advisable to stop the flow of blood from time to time by compressing the rubber tube. After the blood has been injected, the cannula is removed, the vein ligated and the transfusion ended. The whole procedure is conducted without any sense of haste, because the citrate of blood may be kept for many hours without danger of clotting.

So many are the possible conditions in which blood transfusion may be of advantage, and so simple have become the methods of its application that it appeals to the interest of every one that has to do with surgical conditions. The many questions which attend blood transfusion are most satisfactorily considered in this book.

A Treatise on Regional Surgery. Edited by John Fairbairn Binnie, A.M., C.M., F.A.C.S., Kansas City, Mo. Philadelphia: P. Blakiston's Son & Co., volume iii.

With the appearance of the third volume of this treatise on regional surgery is completed the surgical work undertaken by Doctor Binnie. This last volume is the best of the three. It is composed of seventeen monographs written by thirteen different surgeons. Many of the authors are well-known writers, as, for instance, Doctor Binnie himself, Dr. Edward H. Bradford of Boston, Sir W. Arbuthnot Lane of England, Sir Robert Jones of Edinboro, Dr. Howard Lilienthal of New York, Dr. Dean Lewis of Chicago. Monographs written by any of these men would, if written singly, attract attention, and there is no detraction from the value of the writings of these men as grouped in book form under the editorship of Doctor Binnie.

Nearly 150 pages are occupied by Doctor Lewis with the subject of diseases of the upper extremity. This chapter is extremely well done and is interesting and instructive reading. The chapter upon deformities and paralyses of the upper extremity by Doctors Bradford and Soutter is carefully written and very suggestive.

In Sir Arbuthnot Lane's chapter the use of a steel plate in the treatment of fractures of the patella is advised. The writer does not appear to recognize the importance of a suture of the lateral fascia on either side of the injured patella. It is common experience that a simple suture of the patella does not give such satisfactory results as a suture of the patella together with a repair of the torn fascia. It is possible by holding the fragments of the patella firmly in place by a suitable clamp to so suture the soft parts as to maintain contact between the fragments and ordinarily secure bony union. I am also surprised that Mr. Lane makes the statement that the open treatment of fractures requires little skill and entails no risk whatever if the surgeon maintains aseptic precautions. This statement if accepted as it stands is capable of doing great harm among the profession in general. The open treatment of fractures requires great skill and there are great risks attending its most skilful employment.

The articles by Sir Robert Jones are all fine. He writes upon deformities of the lower limbs, congenital dislocations of the hip, and infantile paralysis. They read as if written by a man in active practice and of large experience and are valuable contributions. The chapter upon thoracic surgery by Lilienthal and Gerster is upon a subject which is developing rapidly and is an interesting brief statement.

On the whole, this volume is very suggestive in many particulars. It is impossible and inappropriate to attempt a detailed criticism of the several methods employed by so many different authors. Suffice it to say that the monographs are well written, interesting and full of suggestion. As the volumes stand they give to the reader the present status of each subject satisfactorily. CHARLES L. SCUDDER.

GENITO-URINARY DISEASES AND SYPHILIS. By HENRY H. MORTON, M.D., Clinical Professor of Genito-urinary Diseases to the Long Island College Hospital. 4th Edition, octavo, pages 807. Profusely illustrated. St. Louis: C. V. Mosby, 1918.

The regular appearance of new editions of this book of Doctor Morton speaks well for its value and timeliness. The author is a veteran teacher and practitioner in the field of urology. As genito-urinary surgeon to the Long Island and Kings County Hospital for many years, he has enjoyed unusual opportunities for observation in his chosen field. That he has made the most of these opportunities this volume shows. In each succeeding edition he has kept his book abreast of the advances in urology which the preceding years have made. The book is a most satisfactory presentation of the knowledge and teaching of urologists at the present moment. The large number of original illustrations which are presented add materially to the value of the book. The author's style is concise, his descriptions are clear, his methods of diagnosis are up to date, and the most recent advances in pathology are included in the new edition.

The tendency of urologists at the present time is to omit syphilis from their special field. Syphilis certainly, in its protean form, finds itself allied with almost every department of medicine. While it is frequently transmitted by genital inoculation, it is by no means necessarily so and in a very large proportion of cases is not so at all; all of which constitutes an excellent series of reasons why it should not be included in urology and should be relegated to a field by itself. Doctor Morton, however, still clings to the old methods and devotes a number of chapters to a fairly full discussion of the subject.

MODERN UROLOGY. In original contributions by American authors. Edited by HUGH CABOT, M.D. Philadelphia and New York: Lea & Febiger, 1918.

This book, on the whole, is a discussion of modern-day urology. A perusal of its contents convinces us that it is practically an impossibility for the general surgeon to master thoroughly the science of urology. He

may be proficient in operative technic, but the refinements of modern methods of diagnosis, with delicate instruments requiring skillful manipulation, demand a special training and constant practice.

Syphilis, a specialty in itself, is quite properly not considered in this book. The chapter dealing with the history of urology in America is instructive and inspiring. American surgeons have played a most important part in the development of this exceedingly accurate science.

The chapter on cystoscopes is interesting, but would be much improved by a discussion of some modern instruments other than those devised by the author. The discussion of methods of diagnosis is briefly but ably handled. Every urologist, but particularly every general surgeon, should read it.

Roentgenology of the urinary tract is not particularly well treated, and represents the author's opinions rather than a complete scientific discussion of the subject. The chapter on diseases of the penis also falls short in the same manner. Chapters dealing with the following subjects, however, are splendid scientific contributions, rendering them valuable as references: Syphilis of the genito-urinary organs, anatomy, anomalies and injuries of the penis, genital ulcers, infections of urethra and prostate other than tuberculosis.

Diseases of the urethra in the female is a subject very little written about, but beautifuly discussed in this book. Stricture of the urethra is presented in a masterly manner, as are also the articles on the testicle, scrotum, hydrocele, hematocele, and varicocele. Infections of the testicle and genital tuberculosis, as well as the subject of "Tumors of the Testicle," are all ably written.

All of the articles on the prostate gland except those dealing with sarcoma and calculus are masterpieces. It is unfortunate these two articles were not more complete. The several chapters on the bladder are well written and illustrated, as is the article on the ureter.

The kidney is particularly well discussed in every detail, except that chapter which has to do with anomalies, hydronephrosis, etc. The author of this chapter has evidently referred to the older books for a good part of his information, and instead of a scientific description we have an expression of personal opinions. The articles on bilharziosis and echinococcus have a similar tendency, but the remaining chapters represent a wonderful work of reference and are the last word on the subject.

OSWALD W. LOWSLEY.

CORRESPONDENCE

THE AMERICAN RED CROSS SPLINTS

To the Editor of the Annals of Surgery:

Since arm and leg wounds compose a large majority of the injuries received in battle, there is now among our Expeditionary Force in France an enormous demand for splints—a framework upon which the injured member may rest in the most comfortable position.

The American Red Cross has taken over the job of supplying all splints to the American Expeditionary Forces. The demand for these particular articles is increasing at a great rate due to the increasing activity of American troops on the battle front. To meet this demand the Red Cross has established a splint manufacturing plant of its own in a large French town not far from the battle front. This work is done by French women and by hand.

Most of the leg and arm splints are made of steel rods bent in the shape of a U and are about four feet in length (Figs. 1, 2, and 3). They taper from the bottom up to the top where a semicircular steel rod, attached to each end of the U by a hinge, is padded well and attached. Upon the padded part rests the thigh or shoulder of the injured member. The wounded or broken leg or arm is bandaged between the two sides of the U. The bottom of the U is dented in order that a bandage may be attached to the bottom of the splint and the injured member for the purpose of pulling or applying the necessary weight to force the broken bones or torn muscles into place. It also serves to attach the splint to the foot of a bed or the front of an ambulance so that the wounded leg or arm may be elevated to any position which will give the greatest comfort to the sufferer.

There are numerous variations of this basic splint. Some have a hinge in the centre of both sides of the U, so that an injured leg or arm may be bent at the knee or elbow and bound into position. Some have a hand rest at the end, by which the hand may be bandaged into an immovable position, so that injured muscles will not be moved by unconscious effort. Then there is the U-splint, with an unmovable padded steel circle at the top, which fits close to the leg or shoulder crotch. A splint of this type is also made with hinges so that the arm or leg, stretched straight and fast, may be moved at the thigh or shoulder. There are small wire splints for the foot, the hand and the wrist.

All of them are made by hand in this factory, because of the lack of machinery. Even the welding and varnishing of the steel and wire, as well as the nickeling, is done in the Red Cross factory.

It has established its own manufactory in the war zone of France, in order that there may be fewer transportation delays and better service in the work of relieving as much suffering as possible among American wounded.

W. D. H.

UTILIZATION OF PLATINUM IN UNUSED INSTRUMENTS

To the Editor of Annals of Surgery:

1. In view of the limited supply of platinum in the country and of the urgent demand for war purposes, it is requested that every doctor and dentist in the country go carefully over his instruments and pick out *every scrap of platinum* that is not absolutely essential to his work. These scraps, however small and in whatever condition, should reach Governmental sources without delay, through one of two channels:

(*a*) They can be given to proper accredited representatives of the Red Cross who will shortly make a canvass for that purpose.

(*b*) They may be sold to the Government through any bank under the supervision of the Federal Reserve Board. Such banks will receive and pay current prices for platinum.

By giving this immediate attention you will definitely aid in the war program.

2. It is recognized that certain dental and surgical instruments requiring platinum are necessary, and from time to time platinum is released for that purpose. It is hoped, however, that every physician and every dentist will use substitutes for platinum for such purposes wherever possible.

3. *You are warned* against giving your scrap platinum to anyone who calls at your office without full assurance that that individual is authorized to represent the Red Cross in the matter.

Lieut. Col. F. F. Simpson, M.C., N.A.,
Chief of Section of Medical Industry.

To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS *of* SURGERY
227-231 S. 6th Street
Philadelphia, Penna.